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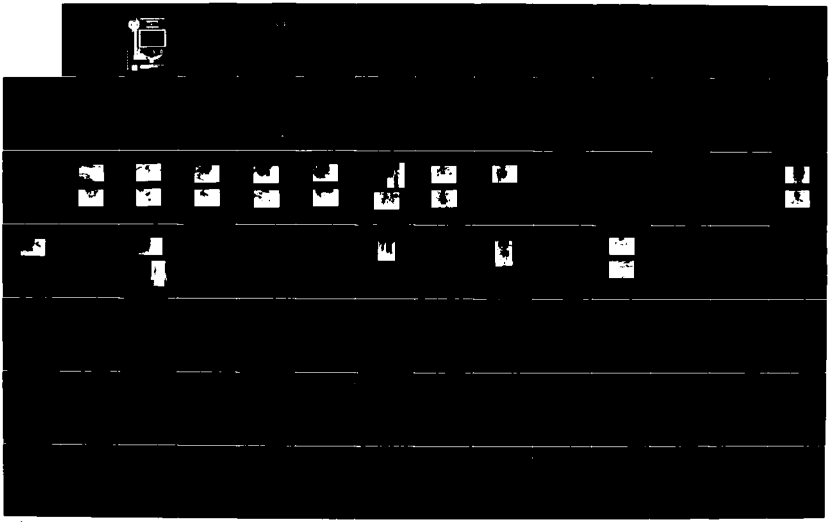

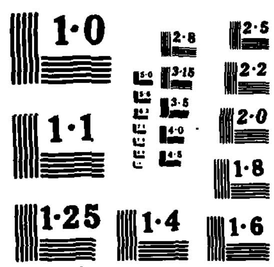
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UNDERWATER FACILITIES

INSPECTIONS

AND

ASSESSMENTS

AT

REFIT PIERS 1&2

TRIDENT REFIT FACILITY

BANGOR, WASHINGTON

FPO-1-82 (02) JUNE, 1981

Performed for:

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C. 20374

Under:

CONTRACT N62477-80-C-0233 - Tasks 2, 3, 4, and 5

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The major objective of the underwater facility assessments conducted at the Trident Refit Facility, Bangor, Washington, was to assess the general underwater structural condition of Refit Piers 1 and 2. Also, for the use in the long range foster facility study, data was recorded describing (Con't)

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deleterious conditions affecting the structure such as marine biofouling, corrosion, deficiencies in coatings, grouting, and cathodic protection, etc. This data will enable comparisons to be made in subsequent periodic inspections so as to determine progressive deterioration with time.

Refit 1 and Refit 2 and the approach trestle were inspected in this survey. Critical conditions discovered during the survey were documented by photographs. In addition, photographs representative of marine growth on both concrete and steel piles were secured.

The inspection of these facilities revealed that piles supporting the piers do not show signs of any sever cracking, spalling, or other serious damage or deterioration. The inspection did reveal that the epoxy coating on the steel cylindrical piles was not an effective method of protection in the tidal zone. The epoxy coating in this area was found to be falling away due to both wave action and marine growth pulling it away when dislodged. Some small locations were found on the steel piles below the tidal zone where the epoxy was removed, presumably during handling, where the cathodic protection system has protected the exposed steel.

The condition of the epoxy in the tidal zone results in recommendations for sample repairs to be made and for frequent inspections to determine the rate of deterioration and the extent of this deterioration. Repairs would entail cleaning the existing epoxy from the steel and the application of an epoxy coating compatible with the environment.

Other than the deficiencies listed above, the facilities were found to be in a condition predictable for the environment and age of the facilities.

FOREWORD

The scope of the underwater inspection of the Refit Piers 1 and 2 at the Trident Refit Facility, Bangor, Washington, and the detail to which it was performed and reported was tailored specifically to the conditions at this facility. This report and the procedure associated with its formation are not intended to be standards for inspections or reports covering other activities. Attempts are being made, however, toward establishing standards for procedures and formats for inspection and assessment reports. Through these standards, inspections performed by different persons, on many facilities and under a wide range of conditions can be effectively compared. It is expected that the inspection and assessment of the Refit Piers 1 and 2, like previous operations mandated under the underwater portion of the Specialized Inspection Program, will contribute significantly toward achieving that objective.

It should be noted that the choice of the level of inspection and the procedural detail to be employed will be an engineering judgement made separately for each activity/facility to suit its unique situation and needs. Accordingly, the procedures used at the Refit Piers, rather than serve as a detailed model for inspections elsewhere, will provide guidance with general applicability to future inspections.

EXECUTIVE SUMMARY

The major objective of the underwater facility assessments ~~conducted at the Trident Refit Facility, Bangor, Washington,~~ was to assess the general underwater structural condition of Refit Piers 1 and 2. Also, for the use in the long range foster facility study, data was recorded describing potentially deleterious conditions affecting the structure such as marine biofouling, corrosion, deficiencies in coatings, grouting, and cathodic protection, etc. This data will enable comparisons to be made in subsequent periodic inspections so as to determine progressive deterioration with time.

Refit 1 and Refit 2 and the approach trestle were inspected in this survey. Critical conditions discovered during the survey were documented by photographs. In addition, photographs representative of marine growth on both concrete and steel piles were secured.

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The condition of the epoxy in the tidal zone results in recommendations for sample repairs to be made and for frequent inspections to determine the rate of deterioration and the extent of this deterioration. Repairs would entail cleaning the existing epoxy from the steel and the application of an epoxy coating compatible with the environment.

Other than the deficiencies listed above, the facilities were found to be in a condition predictable for the environment and age of the facilities. Refer to the following Executive Summary Table for an overview of each facility's construction, recommended repairs and estimated cost of repairs.

TRIDENT REFIT FACILITY

BANGOR, WASHINGTON

EXECUTIVE SUMMARY TABLE

Facility	Year Built or Modified	No. of Vertical Bearing Piles	No. of Batter Piles	Facility Size	Structure	Recommendatio
Refit Pier 1	1976	458 (174 steel) (284 concrete)	671 (48 steel) (623 concrete)	Main Pier - 705'10" x 84'6", Support Building Area - 220' x 250' and Fragmentation Barrier	30" diameter, 3/8" wall steel pipe piles; 24" and 16-1/2" concrete octagonal piles	Reinspect epo coating of ste in tidal zone one year to fu assess deteric
Refit Pier 2	1976	248 (173 steel) (75 concrete)	336 (94 steel) (242 concrete)	Main Pier - 705'10" x 84'6", Staging Building Area - 200' x 38'	30" diameter, 3/8" wall steel pipe piles; 24" and 16-1/2" concrete octagonal piles	Reinspect epo coating of ste in tidal zone one year to fu assess deteric
Approach Trestle	1976	16	150	34' x 812'	16-1/2" concrete otagonal piles	Reinspect Appr Trestle in sev

TRIDENT REFIT FACILITY

BANGOR, WASHINGTON

EXECUTIVE SUMMARY TABLE

. of tter les	Facility Size	Structure	Recommendations	Est. Cost of Recommendations
71 steel) 23 concrete)	Main Pier - 705'10" x 84'6", Support Building Area - 220' x 250' and Fragmentation Barrier	30" diameter, 3/8" wall steel pipe piles; 24" and 16-1/2" concrete octagonal piles	Reinspect epoxy coating of steel piles in tidal zone within one year to further assess deterioration.	$15,000
336 94 steel) 242 concrete)	Main Pier - 705'10" x 84'6", Staging Building Area - 200' x 38'	30" diameter, 3/3" wall steel pipe piles; 24" and 16-1/2" concrete octagonal piles	Reinspect epoxy coating of steel piles in tidal zone within one year to further assess deterioration.	$15,000
150	34' x 812'	16-1/2" concrete otagonal piles	Reinspect Approach Trestle in seven years	$10,000

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This report is a product of the underwater inspection program conducted by the Ocean Engineering & Construction Project Office (FPO-1), Chesapeake Division, Naval Facilities Engineering Command (NAVFACENGCOM) under NAVFAC'S Specialized Inspection Program.

This report specifically addresses below-water conditions of the Refit Piers Numbers 1 and 2, and the approach trestle at the Trident Refit Facility, Bangor, Washington. The purpose of this program is to sponsor in-depth study, base-line assessment, and structural analysis of the underwater portions of selected Naval waterfront facilities. All services required to produce this report were provided by Wiswell, Inc. under Contract No. N62477-80-C-0233, Tasks No. 2, 3, 4, and 5.

1.1 TASK DESCRIPTION

The scope of work for this portion of the program required the inspection of the underwater portion of the two Refit Piers on Delta Pier Complex at the Trident Refit Facility in Bangor, Washington. The quality of the inspection had to be sufficient to provide an adequate general structural assessment of the facilities and to identify areas of sufficient damage and/or deterioration to warrant downrating the structure's capacity, immediate repair, or future, more detailed investigations.

This inspection is part of a new, long range "foster facility study" of underwater structural deterioration and damage. The objective of this study is to establish the "as built" condition of these relatively new structures as a baseline for the subsequent detection of long-range degrading influences and the documentation of the effectiveness of protective measures, repairs, and maintenance. This future tracking of damage and deterioration, and of repair response, requires that this inspection should document various conditions potentially

conducive to structural degradation so as to form a basis for future reference.

1.2 REPORT CONTENT

The report contains a description of inspection procedures, the results of the inspection and analysis of the findings, accompanied by pertinent drawings and photographs. Specifically, the inspection results include a description of the location, construction and function of each facility examined, its observed condition and a structural assessment of that condition. Recommendations for each facility, including cost estimates for any repair work, are also included. Structural assessment calculations and cost estimate breakdowns can be found in the Appendix. Also, as supplementary information, a brief description of the Naval Submarine Base Bangor is provided to define its location, mission, history, existing facilities, climate and other pertinent data.

The purpose of this section is to provide a general description of the Naval Submarine Base in Bangor, Washington. Included in this section will be brief discussions on the Naval Submarine Base's location, mission, history, existing facilities, climatological and meteorological data, and hydrology. This information is provided to supplement the later sections of this report and to support all considerations necessary to accurately assess the structural condition of facilities inspected in this survey.

2.1 LOCATION OF ACTIVITY

Naval Submarine Base Bangor is located on Kitsap Peninsula in Puget Sound, due west of Seattle, Washington. The site is rural in nature, situated on the eastern shore of the Hood Canal. Bremerton, the site of the Puget Sound Naval Shipyard, is 13 miles to the south of Naval Submarine Base Bangor. See figures 1 and 2.

2.2 MISSION OF ACTIVITY

The functions of the Naval Submarine Base Bangor are to provide special maintenance and supply support for the Trident system, including the major tasks of:

1) Ship refit. This function performs resupply, refit and repair operations. The refit facilities include shops, storage, staging and management center, dry-dock, and two refit berths.
2) Missile support. This function, The Strategic Weapons Facility, Pacific (SWFPAC) includes explosive handling wharves, storage facilities for the missiles and the production and assembly facilities. These facilities are similar in capacity to the Polaris missile facilities located at the present Polaris Missile Facility, Pacific, (POMFPAC).
3) Site support. This function, the Trident Support Facility, (TSF) provides the necessary physical security,

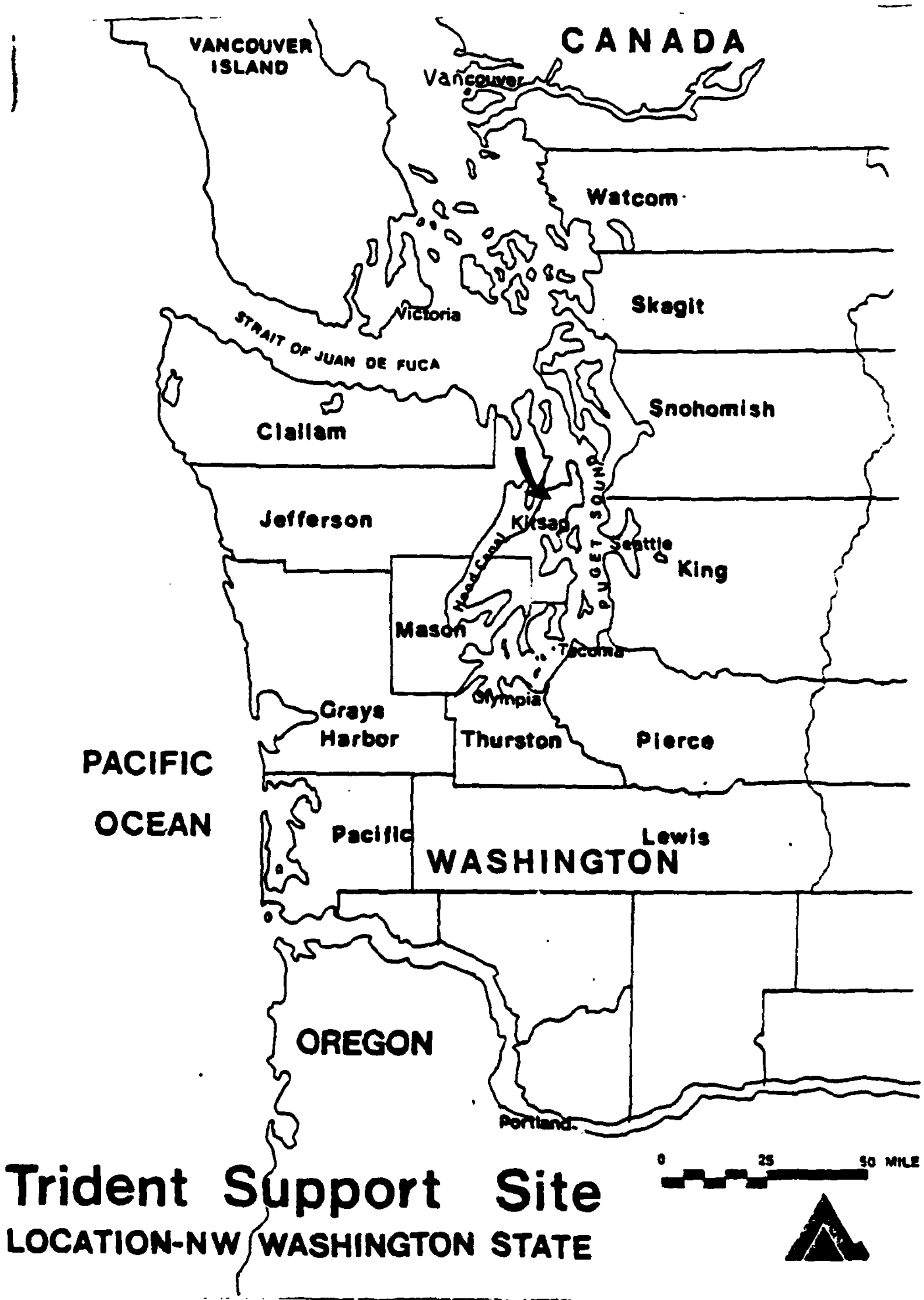


Figure 1 Location Map - Regional

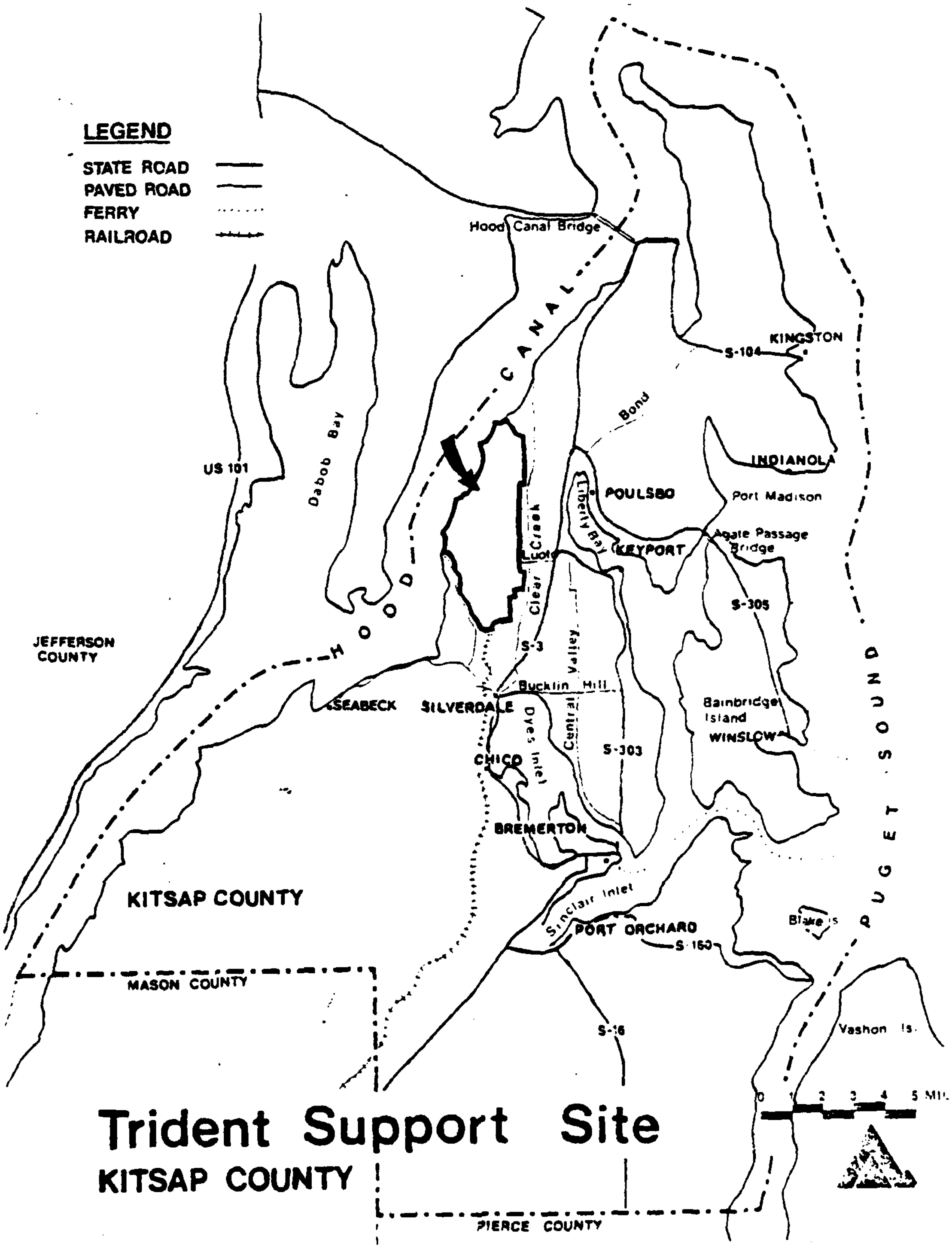


Figure 2 Location Map - Vicinity

administration, public works, housing, and other community and personnel support services and facilities required to maintain the site.

4) Training personnel support. The Trident Training Facility (TRITRAFAC) provides basic courses and refresher training for personnel to initiate and maintain professional skills necessary for operation of this system.

2.3 HISTORY OF FACILITY

Bangor Annex was originally known as the U. S. Naval Magazine facility, established between 1944 and 1945, as the Pacific coast trans-shipment point for ammunition and explosives. In 1950, the Bangor Annex was consolidated with NTS, Keyport, to form the U. S. Naval Ordnance Depot, Puget Sound, Keyport, Washington. In April, 1952, the two activities were returned to independent status. The Bangor Annex was then titled the Naval Ammunition Depot (NAD), Bangor. In 1962, the Secretary of the Navy selected NAD, Bangor as the proposed site for the Polaris facilities to service the Pacific fleet. The Polaris Missile Facility, Pacific (POMFPAC) was established as a tenant of NAD, Bangor, in September, 1963 and went into full operation in December, 1964. In October, 1970, NAD, Bangor, was placed in inactive status and again made the annex of NTS, Keyport. In 1972 it was assigned an ordnance trans-shipment mission in support of southeast Asia operations.

The Bangor Annex consists of over 8500 acres. The major land uses consist of an Administrative and Personnel support area, a family housing area, industrial and production facilities, various type of magazines and barricaded sidings, Marginal Wharf, out-loading facilities, the Polaris Missile Facility, Pacific, and a number of tenant activities.

2.4 EXISTING ACTIVITIES

The Naval Submarine Base Bangor is the homeport of the

Trident system in the Pacific areas. At present the base services and supports the Polaris Missile system while awaiting Trident.

The waterfront facilities of this activity provide the interface between the submarines and the shore support activity. Five functional areas are required, i.e., 1) Refit, 2) Explosive handling, 3) Deperming/Degaussing, 4) Service, and 5) Marginal Wharf. The first three are program requirements for Trident Support Facilities. The fourth is a facility for NTS, Keyport, which replaces similar facilities displaced by Trident. The fifth is the existing Marginal Wharf, with a reduced mission Polaris missile loading and off-loading.

The Waterfront Refit area provides all of the maintenance, repair, supply and hotel facilities for the submarines, with the exception of missile handling and major shop work. The 10-ship requirement includes two Refit Berths, Refit Piers 1 and 2, and one dry dock, as the principal components. Storage and shop facilities are included at the Refit Berths, with Submarine Supply Assistance Team (SUBSAT) facility, Waterfront Satellite Mess (WSM), Launcher Outside Storage (LOS), and Nuclear Industrial Facility (NIF) as minor components.

2.5 CLIMATOLOGICAL & METEOROLOGICAL DATA

Climatic conditions at the Naval Submarine Station Bangor are representative of the Kitsap Peninsula with short, cool, dry summers and mild, wet winters. Conditions are dependent upon the Pacific high and the flow of moisture-laden air which accompanies winter storms from the southwest. Annual precipitation, within a 30 mile radius of Subase Bangor, varies from 30 to 70 inches. Approximately 75 to 80 percent of annual rainfall occurs from October through March. Temperatures above 100° F. and below 0° F. are uncommon. The Kitsap Peninsula and Hood Canal areas are

susceptible to slightly higher winds than other areas of the Puget Sound lowlands. For design purposes, the Bremerton figure of 38.66" of annual rainfall has been assumed for Subase Bangor.

2.6 TOPOGRAPHY

The Hood Canal shore of Subase Bangor is for the most part erosional with steep wave-cut slopes rising to more than 100' above sea level. The sea-shore environment is characterized by slow erosion of the cliff and the deposition of the erosional debris (silts and sands) from the streams to the off-shore deltas. The sea bottom slopes uniformly down toward the depths of the Hood Canal, generally at a slope of about one in ten. This slope is found to be steeper in front of the Marginal Wharf and outside other spits but flatter in the bay, between the Small Craft Pier and Marginal Wharf.

2.7 SOIL CONDITIONS & HYDROLOGY

A major portion of the Subase Bangor area is covered with glacial till, a dense gravel-sand-silt mixture deposited and compressed by the weight of the glacial ice. The till is relatively impermeable. The thickness of the glacial till varies from 0 to more than 40', the thickest being in the southern portion of the annex. Older gravel deposits were found outcropping beneath the silt in the vicinity of Marginal Wharf. These older gravels were found to be very dense and where exposed, are generally weathered with layers up to 10' thick of hard silt and clay containing organic zones. Off shore, along the Subase Bangor shoreline, the sea floor is covered with loose to medium dense granular materials of varying depth. At some locations a wedge of till follows, thickening towards the center of the canal.

In the off shore area, artesian conditions occur in areas where silt strata exist. Presumably, water seeping towards the canal in these areas is trapped beneath the silt hence high water pressures can build up under silt layers whenever the distance to the nearest sea floor seepage outlet is more than several

hundred feet. The existance, at several locations, of relatively impermeable till above appears to increase this artesian pressure. There is a balance of water recharge, slowly seeping to the upland hills into the underlying sands, and water seepage from these sands into Hood Canal. The balance is maintained by a head of water corresponding to the inland water table level, driving the ground water slowly into the canal through the soils. This seepage is quite irregular along the shoreline.

Tide level data for this facility is as follows:

Extreme High Water	(EHW)	Elev. +	8.7
Mean Higher High Water	(MHHW)	Elev. +	5.0
Mean Sea Level	(MSL)	Elev. +	0.00
Mean Lower Low Water	(MLLW)	Elev. -	6.7
Extreme Low Water	(ELW)	Elev. -	11.1

3.1 Level of Inspection

From May 26, 1981 through July 2, 1981, an inspection team consisting of one engineer/diver and three inspection divers performed a Level I underwater inspection of the Refit Pier #1 and Refit Pier #2 at the Trident Refit Facility in Bangor, Washington. Level I underwater inspections of varied scope assess the general condition of a structure utilizing visual/tactile inspection techniques. In an open-type structure, this evaluation generally consists of a close inspection of the majority of the exterior vertical and batter piling and some percentage of the interior piling, as well as a superficial check of all remaining piles. For bulkhead-type structures, visual/tactile observations of the structure's condition at mudline, mid-depth, and splash zone levels are performed. This level of inspection is designed to give a general condition assessment of the structure and should identify any areas that have been mechanically damaged or are in advanced states of deterioration. Documentation (utilizing underwater photography and/or television) and limited physical measurements are provided for verification of the findings.

Level II underwater inspections quantify the structural condition of the facility through definitive engineering-data-measurement techniques. This type of inspection is required in cases where engineering evaluation, structural analyses, and design of repairs are required. Level II inspections normally include visual documentation using underwater television and/or photography and ultrasonic testing techniques. Physical measurements, as outlined in Level I inspections are included, as well as additional measurements of pertinent areas of deterioration or damage.

3.2 Inspection Procedure

Past experience, combined with engineering theory, the level of inspection to be performed, the type of structure being inspected, and the actual on-site conditions dictated the inspection procedures to be used.

The task description called for the inspection of all concrete pilings under the Refit Pier #1 and Refit Pier #2, as well as 25 per cent of the steel pilings under Refit Pier #1 and Refit Pier #2. Fender piles were not included in the description, but were superficially examined during the detailed inspection of the supporting piles.

The underwater inspection team consisted of one engineer/diver and three inspection diver/tenders. Due to the configuration of the structure, the depths involved, and to insure an accurate inspection and accurate note-taking, surface-air-supplied diving was employed. The dive station consisted of a compressor, volume tank, two-way communications radio, pneumofathometer, and back-up air supply system. Inspection depths and dive durations required a decompression chamber to be operational at the dive location. The surface-air-supplied method of diving allowed the inspecting diver to describe, in detail, any damage or deterioration that was encountered via two-way communications. The inspecting diver would inspect a pile, cleaning growth as necessary, looking for cracks, voids, rust stains, loss of epoxy, exposed reinforcing steel, and other signs of damage or deterioration. After descending down one pile, inspecting it in a semi-spiral fashion to view each face, the engineer/diver would move to the next pile and ascend while inspecting for damage or deterioration. (See Figure 3).

The inspection of the facility included close examination for three major types of problems. These problems were mechanical damage after construction, damage during construction, and deterioration occurring since construction. Mechanical damage after construction was primarily limited to damage due to impact of berthing vessels. This damage was limited to the outer rows of each bent and the connecting pile cap. Damage during construction would primarily be cracks in the piles, when driven, which would then allow water intrusion into the piles and allow spalling and oxidation of the reinforcing steel. In steel piles the damage during construction was primarily the loss of the epoxy coating during handling of the piles prior to placement. Deterioration of the piles would be in the form of erosion and chemical attack on the concrete piles while the steel piles would show oxidation of exposed steel and loss of the epoxy coating.

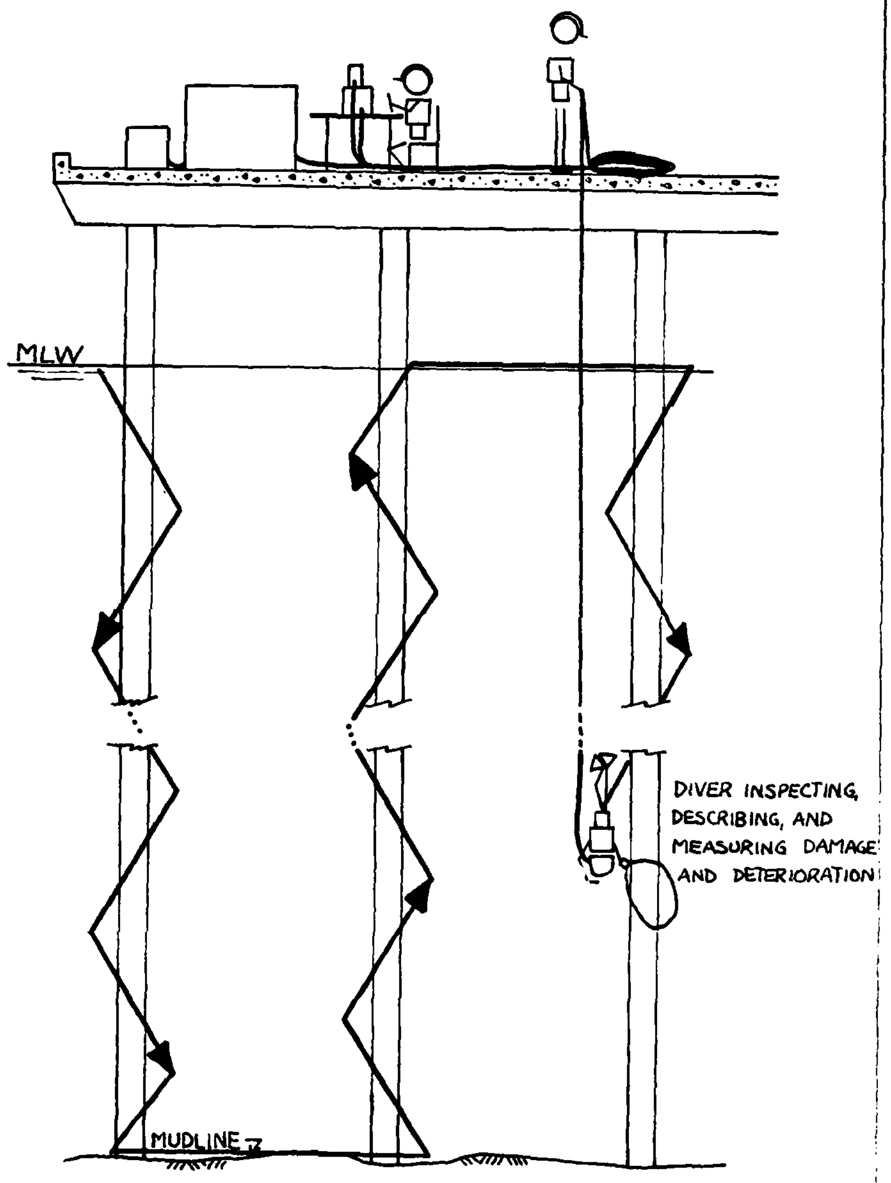


FIG.3 TYPICAL DIVER INSPECTION PATH

WISWELL, INC. 3280 POST RD. SOUTHPORT, CT	CHESAPEAKE DIVISION NAVFACENGCOM WASHINGTON, DC	REFIT-1 & REFIT-2 TRIDENT REFIT FACILITY BANGOR, WASHINGTON

Documentation in the form of still photographs and a video tape was obtained of typical and irregular conditions. Photographs of damage and deterioration both under-water and above-water, but below deck level, were taken. Soundings were taken at locations along each bent and are presented on the inspection plans in the back of this report.

3.3 Inspection Equipment

Equipment used for inspection of the piles included a sharp pointed probe, a Nikonos II under-water camera with Vivitar strobe, dive lights, 100' sounding tape, scraping tools and dive knives.

Choice of equipment was made as a result of past experience, chosen for its effectivensss and ease of operation in an under-water environment.

1) Piles: 7000 psi 28-day strength concrete
2) Deck: 6000 psi 28-day strength concrete
3) Rebar: ASTM A615 Grade 60
4) Prestressing Steel - Seven wire ASTM 416
5) Spiral Reinforcement for Piles:
   ASTM A82 Fy = 70KSI

Material for steel piles is ASTM A 252, Grade 2 or ASTM A 53, Grade B, Fy = 35KSI

The approach trestle to Refit 1 is composed of a reinforced concrete deck supported by 166 concrete plumb and batter piles. These piles are 16-1/2 inch precast octagons with a maximum length of 86 feet. The piles are arranged in 41 bents, 38 of which consist of 4 batter piles. Each of these bents contains 2 pairs of batter piles, one pair of piles opposing each other battered in the north-south direction, and the other pair opposing each other battered in the east-west direction.

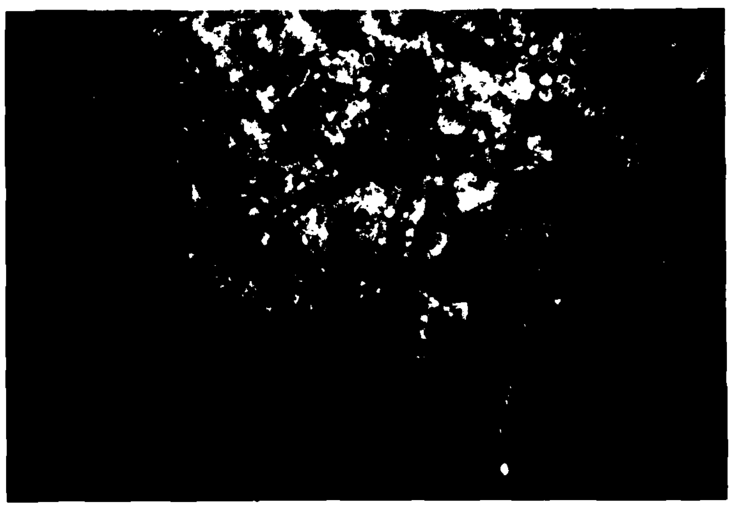
Refit 2 comprises the northern portion of the Delta Pier. It was designed to perform the same function as Refit 1 and has 705 feet-10 inches of berthing space to accommodate a single Trident submarine. The berthing space is oriented at an angle of 60° to that of Refit 1.

Refit 2 expands in width from 67'8" at the western end to 310'7" at the eastern (shoreward) end. It extends a distance of 609 feet at a bearing of N 68° W from the west edge of the drydock. Similar to Refit 1, Refit 2 maintains both a staging and a sub-station building to assist in submarine refit activities.

Refit 2 consists of a reinforced concrete deck supported by 317 concrete piles and 267 steel piles. The concrete piles are 24 inch hollow octagons with a maximum length of 144 feet. The steel piles are 30 inch outside diameter, 3/8 inch wall piles with a maximum length of 204 feet. These piles are identical to those employed in Refit 1 with the same material lists and load capacities applying.

Photograph No. 1

Pile 2-11, Mean Sea Level, cylindrical steel pipe pile.



Photograph No. 2

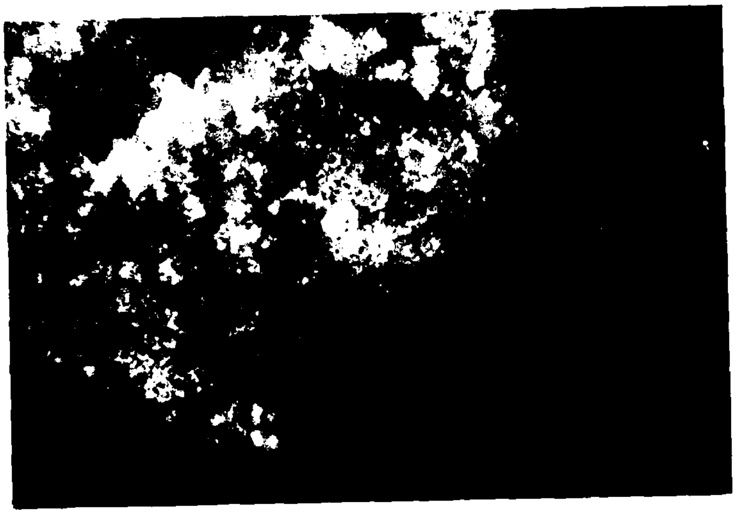
Pile 2-11, Elevation -10.0. Note epoxy peeled away.

Photograph No. 3

Pile 2-11, Elevation -20.0.

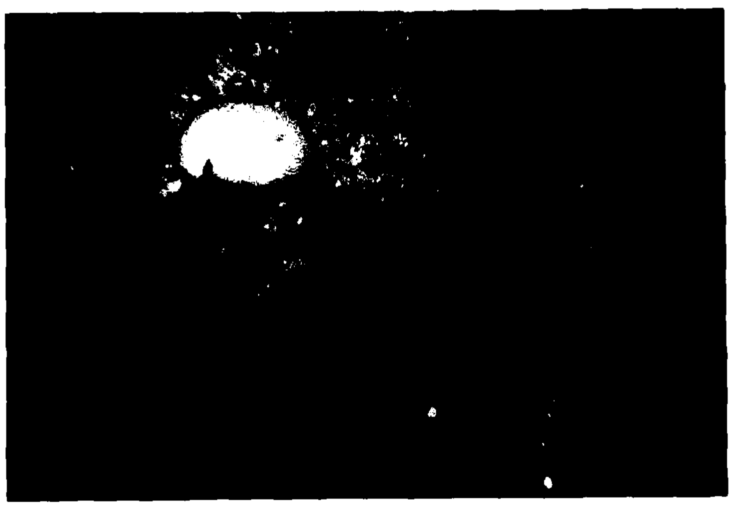
Photograph No. 4

Pile 2-11, Elevation -30.0. Note epoxy missing and gray coating from cathodic protection system.



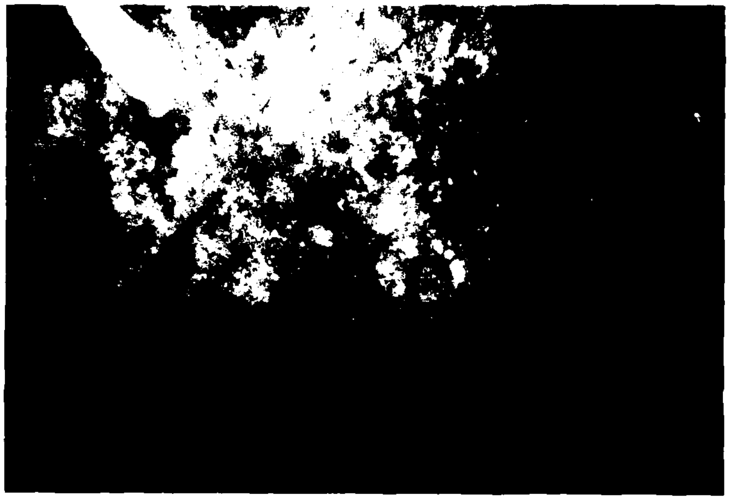
Photograph No. 5

Pile 2-11, Elevation -40.0. Barnacles, sponges, nudibranch.



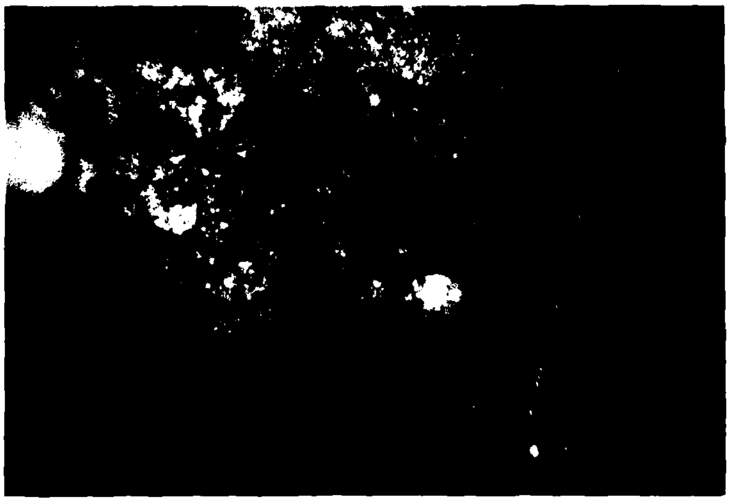
Photograph No. 6

Pile 2-11, Elevation -50.0. Typical growth.



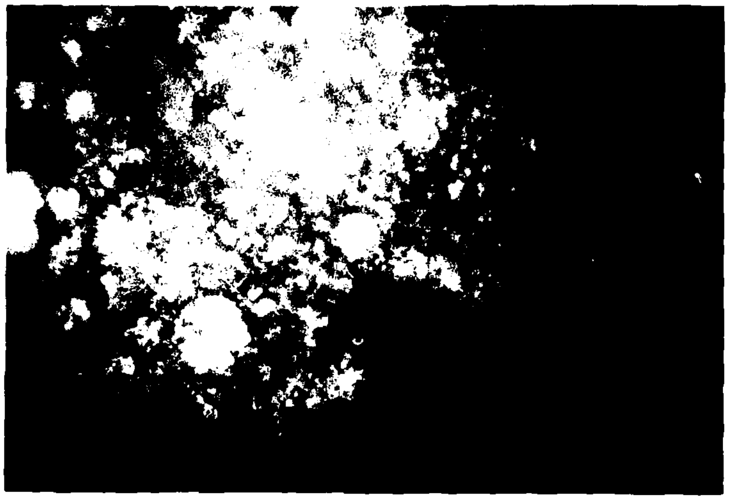
Photograph No. 7

Pile 2-11, Elevation -60.0. Barnacles, sponges, rock oysters.



Photograph No. 8

Pile 2-11, Elevation -70.0. Barnacles, nudibranchs.



Photograph No. 9

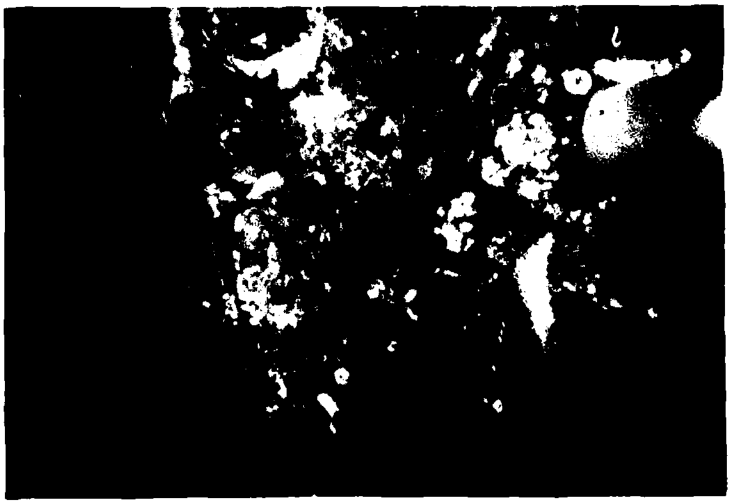
Pile 2-11, Elevation -80.0. Large area of epoxy missing, cathodic protection system actively protecting exposed steel.

Photograph 10

Pile 2-11, Elevation -90.0 at harbor bottom. Small area of exposed steel, protected by cathodic protection system.

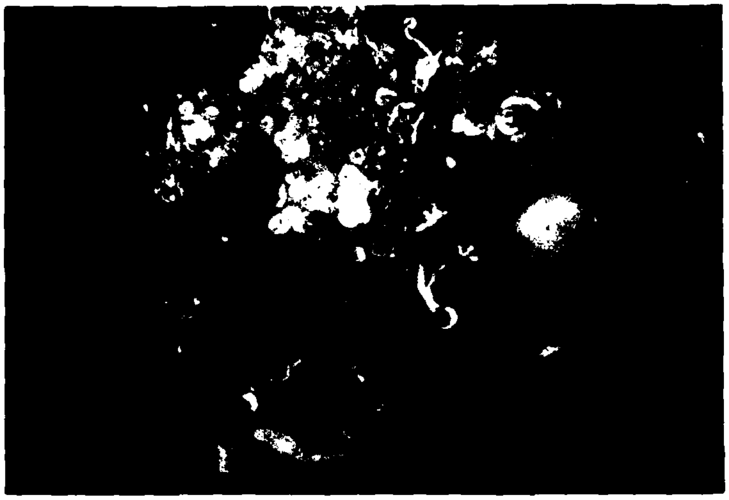
Photograph No. 11

Pile 7-4, Mean Sea Level, octagonal concrete pile. This zone changes from heavy barnacle and mussel growths to heavy worm growth.



Photograph No. 12

Pile 7-4, Elevation -10.0. Barnacles, oysters, some anemones.

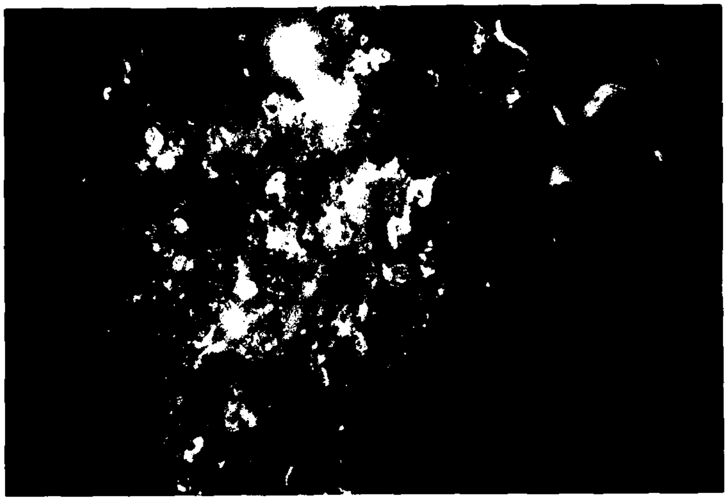


Photograph No. 13

Pile 7-4, Elevation -20.0. Barnacles, anemones, nudibranchs.

Photograph No. 14

Pile 7-4, Elevation -30.0. Barnacles, anemones, rock crabs.



Photograph No. 15

Pile 7-4, Elevation -40.0. Nudibranchs, tubeworms, oysters.

4.1.2 Observed Inspection Condition

As a baseline assessment of the condition of a recently built facility, the inspection team was not surprised to not find any extensive deterioration. Deterioration of the epoxy coating of the steel piles was encountered and will be presented later in the report. The amount of marine growth present on the concrete and steel piles was very heavy in some areas. This marine growth varied between concrete and steel piles and between outer rows of piles and inner rows of piles.

Findings on the composition and levels of marine growth in this report are summarized in three ways. Levels of marine growth are summarized by assigning to each pile a number from one (1) to three (3) indicating the degree of growth coverage on the pile, and a letter from a to c indicating the overall thickness of coverage. The breakdown of this system appears below:

A. Percent Coverage
   1 - heavy (80-100%)
   2 - medium (60-80%)
   3 - Light (less than 60%)

B. Thickness of Coverage
   a - thick (1-1/2 inches or greater)
   b - average (3/4 inch to 1-1/2 inches)
   c - thick (3/4 inch or less)

It should be noted that the thickness measure refers to growth consisting primarily of barnacles, mussels, oysters, scallops, and other "hard" fouling organisms rather than to anemones and tube worms, for example, which are often found in clusters up to two feet in length. It should also be understood that these assigned values represent an overall description of a pile and conditions may vary at specific depths. This data is presented in the appendix.

Marine growth on the concrete piles was found to be divided into four major zones:

A. Zone 1: +8' to -8' M.L.L.W.
"Hard" fouling zone: barnacles, mussels, oysters.

B. Zone 2: -8' to -20' M.L.L.W.
Tubeworm zone.

C. Zone 3: -20' to -65' M.L.L.W.
Anemone zone.

D. Zone 4: -65' and deeper M.L.L.W.
Light growth zone.

It should be recognized that there is considerable overlapping of these zones and that they are not distinguishable on all of the pilings. Figures 4 and 5 show the approximate ranges of these types of marine growth for concrete piles and steel piles.

Zone 1 encompasses the splash zone, the intertidal zone, and the upper subtidal zone. In this zone the thickest growth is encountered and the piles are nearly always 100 percent covered. Growth in the splash zone, where there is only intermittent wetting, consists primarily of a thin covering of barnacles and scattered mussels. The intertidal zone, immediately below the splash zone, contains approximately ten vertical feet of heavy mussel, oyster and barnacle growth, frequently in excess of two inches thick (see photograph 16).

Zone 2 is characterized by a heavy concentration of tube worms varying in length from a few inches to nearly two feet. Barnacles and mussels are also present in large numbers in this zone, along with red and yellow sponges, nudibranchs, tunicates and a few anemones (see photograph 17).

Zone 3 represents an area of heavy anemone growth frequently occurring in lengths up to two feet. The majority of the anemones are plumose anemones and were white, orange, or brown in color. In addition to anemones there are scattered appearances of sea urchins, sea cucumbers, calcareous tube worms, oysters, nudibranchs, tunicates, sea squirts, chitons, sea stars, and scallops (see photograph 18).

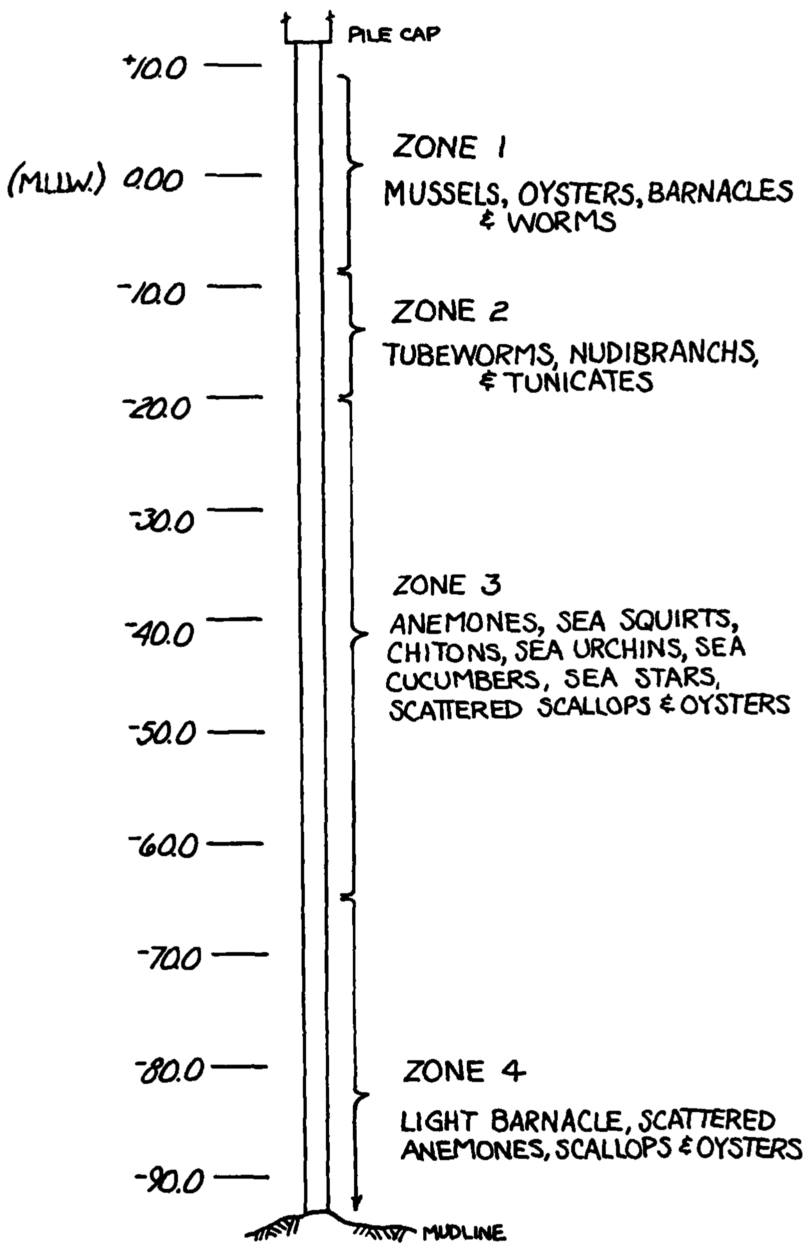


FIG. 4 MARINE GROWTH PROFILE- CONCRETE PILES

WISWELL, INC. 3280 POST RD. SOUTHPORT, CT	CHESAPEAKE DIVISION NAVFACENGCOM WASHINGTON, DC	REFIT-1 & REFIT-2 TRIDENT REFIT FACILITY BANGOR, WASHINGTON

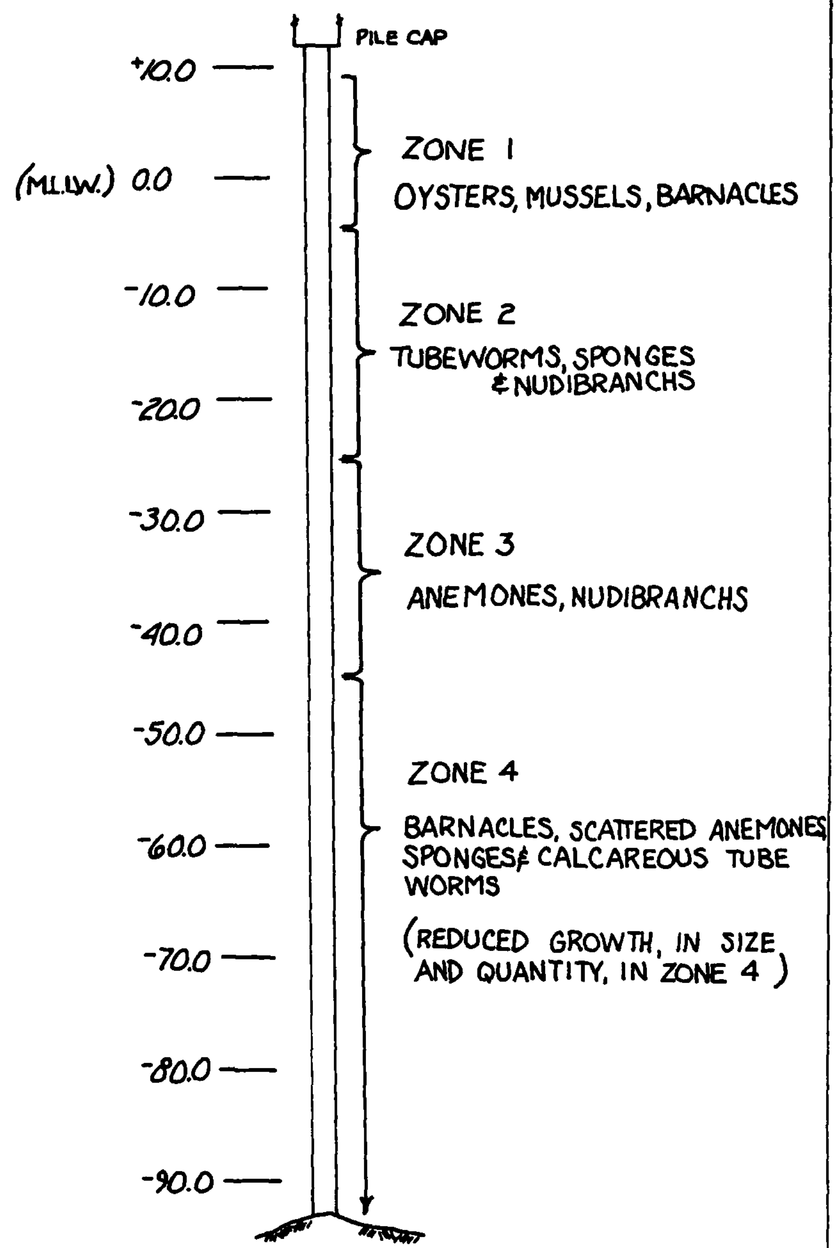
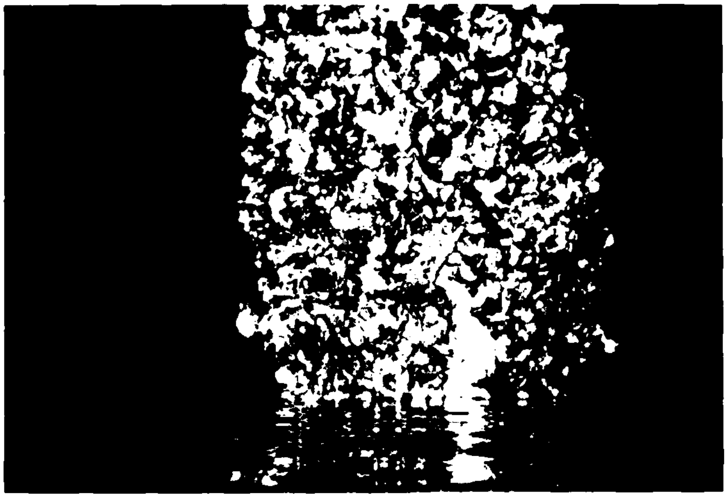


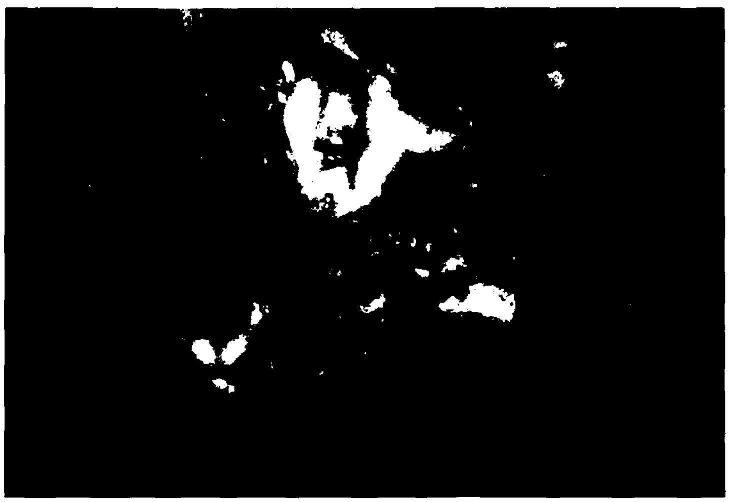
FIG. 5 MARINE GROWTH PROFILE - STEEL PILES

WISWELL, INC. 3280 POST RD. SOUTHPORT, CT	CHESAPEAKE DIVISION NAVFACENGCOM WASHINGTON, DC	REFIT-1 & REFIT-2 TRIDENT REFIT FACILITY BANGOR, WASHINGTON



Photograph No. 16

Pile 34-4, Zone 1, the Intertidal Zone. This zone is approximately ten vertical feet of heavy mussels, oysters, and barnacles, often in excess of two inches thick.



Photograph No. 17

Pile 34-4, Zone 2. Barnacles, sponges, nudibranchs, mussels.

Photograph No. 18

Pile 34-4, Zone 3. Anemones, sea urchins, sponge and tube worms.

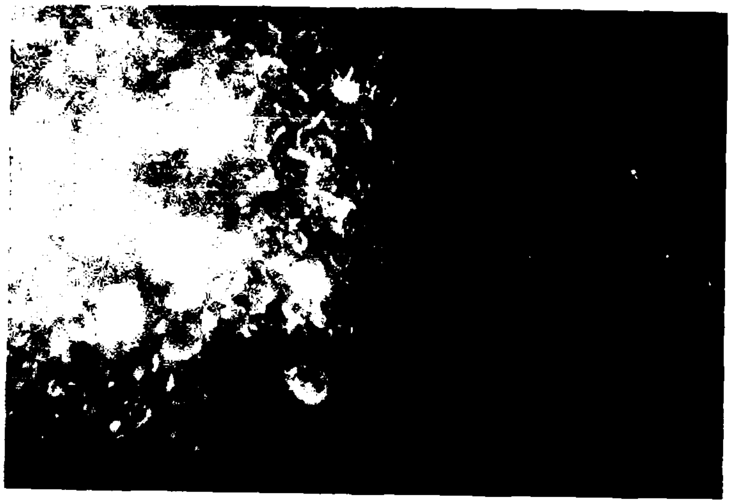
In Zone 4 marine growth gradually diminishes leaving only a thick covering of barnacles approximately one-half inch thick toward the mudline. Interspersed among the barnacles are very small scallops and oysters along with occasional concentrations of calcareous tube worms, sea squirts, and small anemones (see photograph 19).

The amount of available illumination is the primary limiting factor in determining the degree of thickness and the coverage of marine growth on the piles. As anticipated, growth is found to be heaviest on outboard piles where sunlight is available (see photograph 20). In these areas, coverage is 100 percent and thickness is often greater than two inches. Coverage on the same piles generally decreases to 80 to 90 percent at mid-depths and continues to decrease near the mudline.

In interior regions where piles are shaded from illumination, marine growth is dramatically reduced. This is particularly evident among the piles under the central section of the Delta Support Facility on Refit 1. Some of these piles are well over one hundred feet from any direct light. Growth coverage is generally diminished to the 50 percent range with a thickness of approximately one-half inch. In contrast to the outer piles, there is very little variation in growth coverage and thickness along the length of the pile.

Not only the amount of growth, but the variety of organisms on the piles decline in the interior sections. Noticeably absent are mussels, oysters, and all but a few anemones. Tube worms fare significantly better in this area and are often found in heavy concentrations below the low water mark. The majority of the few barnacles to be found in these areas are dead and are easily removed by light scraping.

Marine growth on the steel piles differs in three ways from that on the concrete piles. First, it does not exhibit the variety of organisms observed on the concrete piles. Second, the thickness of the growth never approaches that seen on the intertidal areas of the concrete piles. Finally, the thickness and the composition of the coverage is more consistent along the entire length of the pile than what is noted on the concrete piles.



Photograph No. 19

Pile 7-4, Zone 4. Thick growth of barnacles with nudibranchs and occasional oysters and sea anemones.

Photograph No. 20

Typical pile near available sunlight showing heavy growth in intertidal zone.

Roughly the same zones of growth apply to the steel piles as were employed with the concrete. Zone 1 is almost identical with complete coverage of the piles by barnacles, oysters, and mussels. Thickness is generally in the one to two inch range.

Zone 2, or the tube worm zone, appears on a smaller percentage of steel piles than on concrete piles. In addition, tube worms appear in smaller numbers and sizes than those observed on concrete piles. On those piles for which this zone is not clearly defined, there is a mixed zone of sponges, light anemones, and barnacles.

The anemones in Zone 3 also occur in lesser numbers on steel piles than on concrete piles. There is, however, a similar increase in the diversity of organisms at mid-depth with the appearance of sponges, nudibranchs, and a few tunicates.

With its light covering of barnacles, Zone 4 also exhibits strong similarity to its counterpart on the concrete piles. Some differences are noted in the appearance of a greater number of oysters and scallops at lower depths.

Coverage in all zones is in the 80 to 100 percent range with widely scattered exceptions. This high degree of coverage is probably a result of the ready availability of sunlight at nearly all of the steel pile locations.

4.1.3 Structural Condition Assessment

The purpose of this section is to present a qualitative description of the structural condition of the facilities based upon the inspection data. Each concrete pile supporting Refit 1 and Refit 2 was examined. An inspection was also made of 25 per cent of the steel piles supporting Refit 1 and Refit 2. Pile plans, located in the Appendix, denote which piles were inspected as well as the structural condition of the specific piles.

In that the two types of piles supporting the facility are of different materials, and have different structural problems, the concrete piles and steel piles will be addressed separately.

The following rating system was employed to describe the overall condition of the concrete piles:

A. No damage, deterioration, or structural problems noted.
B. Minor spalls, rough, uneven surface.
C. Large spalls, cracks, exposed rebar.
D. Severely damaged pile.
E. Splices, spacers.

In general the piles of Refit 1 were found to be in excellent condition with dense, hard concrete and sharp, well-defined edges. Many of the piles inspected exhibited a large number of small air pockets left by the original forming process. These pockets were generally less than 1/4 inch deep and one square inch in area. There was no evidence of exposed reinforcing steel.

A total of 907 twenty-four inch octagonal concrete plumb and batter piles were inspected at Refit 1. The condition rating breakdown shows 906 of the piles with an "A" or undamaged rating and only one pile, 39-9, with a rough enough surface to merit a "B" rating.

All 166 of the 16-1/2 inch octagonal concrete piles supporting the approach trestle at Refit 1 were examined. The condition survey again revealed only one pile which did not merit an "A" rating. Pile 6-1 was found to have a rough, uneven surface.

However, scraping the pile with a probe showed the concrete on this pile to be hard and strong.

An inspection was performed on all 317 twenty-four inch hollow octagon piles at Refit 2. Like those at Refit 1, the concrete piles of Refit 2 revealed hard, dense, concrete with distinct edges. All of the concrete piles of Refit 2 received an "A" rating.

The inspection revealed three sets of double concrete piles which were the result of an original pile failing during construction and a new pile being driven adjacent to it (see photograph 21).

An in-depth inspection was made of 25 percent of the steel piles in Refit 1 and Refit 2. In both cases, the piles have an outside diameter of 30 inches and a 3/8 inch wall. The following rating system was employed to describe the condition of the steel piles:

A. No damage, deterioration, or structural problems noted.
B. Minor rust spots and peeling epoxy.
C. Minor dents (1/4 inch deep or less), major rust spots.
D. Large dents, cracks.
E. Severely damaged pile.

In addition to the above system, notes were made on the effective functioning of the cathodic protection system.

A total of 58 of the 222 steel piles at Refit 1 were examined in detail while others were given a cursory inspection from a boat or during a swim-through inspection. An "A" rating, or no damage or deterioration, was given to 30 piles. Minor rust spots were found on the 22 piles which received a "B" rating, while 4 piles were determined to have major areas of rust and/or dents and were rated "C". There were no cracks or large dents noted, nor were there any severely damaged piles.

Photograph No. 21

One of the three sets of piles where the original pile failed during pile driving operations and an additional pile was installed, Pile 24-20.

The greatest amount of rust was found in the upper tidal and splash zones. The rusted areas were concentrated on the outboard piles, particularly on the piles at the western edge of the pier. This condition may be the result of heavier wave attack in the exterior regions, causing the splash zone to be hit with highly oxygenated sea water. This condition could be expected to both increase the wear on the pile coating and to lead to more rapid corrosion, It should be noted that due to this area not being consistently submerged, the cathodic protection is ineffective in areas above the mid-tide level. Because of this, the epoxy coating is almost entirely responsible for the protection of the upper areas of the pile from corrosion.

During a swim-through, surface inspection divers noticed considerable deterioration of the epoxy coating on several piles which had not been part of the detailed inspection. In some cases the area of deterioration extended well below the splash zone into the intertidal zone. Pile 19-10, for example, exhibited an area 8 inches wide and extending from the splash zone to approximately 4 feet below the high water mark. In this area mussels were easily removed in large clusters, taking pieces of peeled and broken-up epoxy with them (see photograph 22). A follow-up inspection by boat revealed similar, though usually not as serious, deterioration on as many as 30 percent of the steel piles.

Small areas of peeled epoxy were discovered in some instances along the entire length of the steel piles. Some of this deterioration may have been caused by rough handling during transportation or installation. However, much of it appears to have been the direct result of the attachment of marine growth to the pile surface. Barnacles, for example, seem to be able to pierce the surface of the epoxy coating and actually lift the coating from the pile. Mussels, oysters, and other sessile creatures also cause damage to the coating. This is particularly evident in areas where oysters have been pulled off or have fallen off the piles. In almost every case this left a small area approximately 1 inch in diameter where

Photograph No. 22

Pile 19-10. Area of epoxy missing, with more epoxy coming away when mussels and barnacles are removed.

the epoxy had been removed.

Pile 2-11 provides a good example of epoxy deterioration at various depths. The pile was photographed at ten (10) foot intervals along the pile and are presented in photographs 1 through 10. The first area of light rust, about 5 inches square, was detected at approximately 1 foot below mean lower low water (see photograph 1).

At the -15 and -30 foot levels, two larger areas of exposed steel were located (see photographs 2 and 4). The -15 elevation shows an area of clean steel 4-1/2 inches wide by 2-1/2 inches high that was also slightly indented. Photograph 4 shows a similar area of deterioration at the -30 elevation. Further down the same pile at -76 feet a very large area of peeled epoxy was encountered. The steel in this area was peppered with small rounded dents as if it had been struck continuously with a rounded object. The maximum depth of indentation was 1/4 inch (see photograph 23).

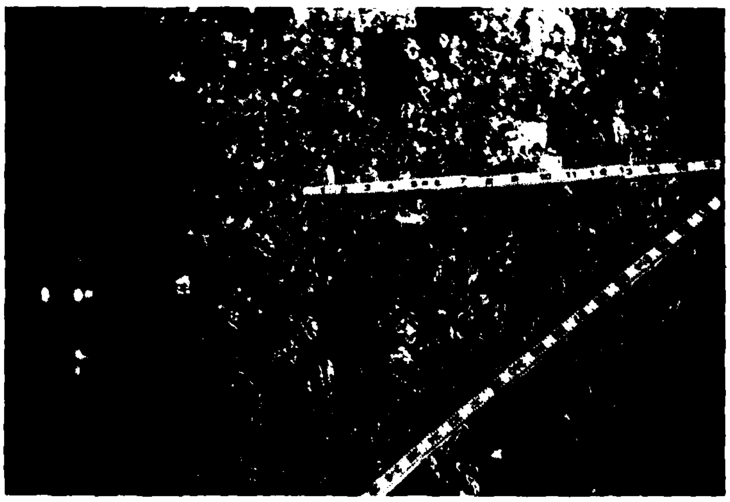
In each of the above instances, and nearly all of the other submerged areas where the epoxy coating is not present, the cathodic protection system is effectively halting any continued deterioration. The gray protective coating formed on the exposed steel by the cathodic protection system was found at each location where epoxy was missing from a pile below the tidal zone. The tidal zone, where some unprotected deterioration was found, can not be protected by the cathodic protection system since it is above the water surface during the tidal cycle.

The detailed inspection at Refit 2 covered 73 of the 277 steel plumb and batter piles. An undamaged "A" rating was given to 68 of these. Peeled epoxy and/or rust was found on 4 piles and a large dented area was located on one pile.

Peeling epoxy and minor levels of corrosion were again found to be a significant problem in the splash and upper tidal zones at the west end of the pier. Photographs of some of these areas were taken during a follow-up investigation made from a boat. Photograph No. 24 of pile R-10 shows a typical area of light scale and peeled epoxy in the splash zone of an outboard pile.

Photograph No. 23

Pile 2-11 at elevation -76.0. Dents and loss of epoxy.



Photograph No. 24

Pile R-10 at intertidal zone. Loss of epcxy in upper sections of an outboard pile.

Pile B-2 was found to have an area of clean steel about 6 inches wide by 3-1/2 inches high containing three parallel dents, at a depth of 18' MLLW. The dents appear to have been made by a chain and vary in depth from 1/4 to 3/8 inches. Photograph 9 shows the area and reveals the steel surface to be clean and with a grayish coloration due to the cathodic protection system, once again showing the cathodic protection system performing its function.

4.1.4. Recommendations

It is recommended that an additional, more detailed inspection be performed of the deterioration of the epoxy coating on the steel piles of both Refit-1 and Refit-2 in the tidal zone. This loss of epoxy exposes bare steel to the elements and when not submerged the cathodic protection system is not capable of protecting the steel.

The detailed inspection should involve both the rate of deterioration as well as the reasons for the failure of the epoxy to completely adhere to the piles. Further documentation of the presence of oxidation of the exposed steel and the rate of oxidation would allow an evaluation of the time frame allowed for repairs. This study would have ready access by small boat and would not require any diving, being totally exposed at low tide. Although the structure has been recently built, the piles, left without adequate protection will continue to oxidize, leading to deterioration of the piles.

TABLE OF CONTENTS FOR APPENDIX

STRUCTURAL ANALYSIS CALCULATIONS

In that the investigation found no serious damage or deterioration of the supporting piles at this time, the structure is considered as-built structurally. Those conditions which will lead to structural weakening of the structure, most notably the tidal zone protection of the steel piles, have been presented and discussed elsewhere in the report.

CUMULATIVE LIST OF MARINE ORGANISMS
IDENTIFIED DURING PILING INSPECTION
AT REFIT-1, REFIT-2, EHW-1

Family/Species	Common Name
MOLLUSCA	
Chlamys hastata hericia	Pacific pink scallop
Chlamys rubida	Pacific pink scallop
Crassostrea gigas	Pacific oyster
Hinnites giganteus	Purple-hinged scallop
Mytilus californignus	California mussel
Mytilus edulis	Bay or Blue mussel
Octopus dofleini	Pacific octopus
Archidoris montereyensis	Sea lemon
Armina californica	Striped nudibranch
Triopha catilinae	Common orange spotted nudibranch
Acmaea mitra	Whitecap limpet
Diodore aspera	Keyhole limpet
Searlesia dira	Spindle whelk
ECHINODERMATA	
Leptasterias hexactis	Six-ray star
Parastichopus californicus	Californic sea cucumber
Pycnopodia helianthoides	Sunflower star
Solaster dawsoni	Morning sun star
Strongylocentrotus droebachiniensis	Green sea urchin
CORDATA	
Ascidia paratropa	Glassy sea squirt
Corella willmeriana	Transparent sea squirt
Halocynthia aurantium	Sea peach
ANNELIDA	
Dodecaceria fewkesi	Cemented tube worm
Eudistylia Vancouveri	Feather duster worm
Serpula vermicularis	Calcareous tube worm
PLATYHELMINTHES	
Tubulanus polymorphus	Primitive ribbon worm
Tubulanus sexlineatus	Lined ribbon worm
COELENTERATA	
Metridium senile	Plumose anemone
ARTHROPODA	
Balanus glandula	Acorn barnacle
Balanus nubilus	Giant barnacle
Pandalus dance	Coonstripe shrimp
Cancer magister	Dungeness crab
Cancer productus	Red rock crab
Ellassochirus gilli	Orange hermit crab
Oedignathus intermis	Granular claw crab
Oregonia gracilis	Decorator crab
Pugettia producta	Kelp crab

CUMULATIVE LIST OF MARINE ORGANISMS IDENTIFIED DURING PILING INSPECTION AT REFIT-1, REFIT-2, EHW-1

Family/Species	Common Name
PORIFERA	
Adocia mollis	White encrusting sponge
Cliona celata	Yellow boring sponge
Halichondria panicea	Crumb of bread sponge
Ophlitaspongia pennata	Red sponge

CUMULATIVE LIST OF MARINE ORGANISMS
IDENTIFIED DURING PILING INSPECTION
AT REFIT-1, REFIT-2, EHW-1

Fish Species

Family/Species	Common Name
CHIMAERIDAE	
Hydrolagus colliei	Ratfish
CLUPEIDAE	
Clupea havengus pallasi	Pacific herring
EMBIOTOCIDAE	
Cymatogaster aggregata	Shiner perch
Embiotoca lateralis	Striped perch
Rhacochilus vacca	Pile perch
SCORPAENIDAE	
Sebastes auriculatus	Brown rockfish
Sebastes caurinus	Copper rockfish
Sebastes flavidus	Yellowtail rockfish
HEXAGRAMMIDAE	
Hexagrammos decagrammus	Kelp greenling
Ophiodon elongatus	Lingcod
COTTIDAE	
Artedius harringtoni	Scalyhead sculpin
Enophrys bison	Buffalo sculpin
Scorpaenichthys marmuratus	Cabezon
STICHAEIDAE	
Anoplarchus purpurescens	High cockscomb
Anarrichthys ocellatus	Wolf-eel

CATHODIC PROTECTION SYSTEM

Protection of the steel cylindrical piles at Refit 1 and Refit 2 from the detrimental effects of the environment is provided by two methods. Short term protection is supplied by the application of a coal-tar epoxy coating. The coating is a cold-applied thin film combining an epoxy resin with a coal-tar resin. The coating cures by polymerization and is highly resistant to chemical and elemental attack.

Cathodic protection, the second method employed at the Refit piers, provides continuous resistance to electrolytic corrosion. Electrolytic corrosion decay is caused by the formation of localized galvanic cells or "corrosion batteries" on the metal surface. The cells are created by areas of varying electrical potential forming anodes and cathodes on the metal surface. When these areas are connected by an electrolyte (sea water in this case) an electrical current is formed in the direction of the cathodic surface. At the same time rust and pitting is caused by release of metallic ions at the anodic surface.

The object of cathodic protection is to control corrosion by providing a substitute anode for the anodic surfaces of the corroding metal. In an electrolytic cathodic system direct current from an external power source is supplied through an auxiliary anode to the metal to be protected, causing the entire surface to become cathodic. This "impressed" current prevents the flow of electrons in local cells on the protected surface which in turn inhibits corrosion by preventing the release of metallic ions.

An impressed current system is employed at Refit 1 and Refit 2. The system entails the use of forty-seven oil immersed rectifiers, one between every pair of steel pile bents. Each rectifier is connected to a series of copper anodes encased in thick fluoro-

polymer and polyethylene insulation and implanted in the bottom. The current and voltage of each of these rectifier-anode systems may be varied to achieve the levels necessary to protect the individual piles.

Every three months a potential reading is taken at each pile to determine if the current and voltage requirements are being met. Readings may vary during these periods for reasons such as change in water temperature, current, and salinity. If for these reasons, or other reasons, the potential reading changes, the system is rebalanced.

As a rule, the requirements for current density can be expected to increase as the structure ages and the coal-tar epoxy coating gradually fails. This failure may be caused by such varied influences as rough handling during transportation and installation, marine organisms, or by normal deterioration such as blistering by the sun, abrasion by current, or wave forces. In these areas "holidays", areas of peeled epoxy exposing bare metal, appear and gradually increase in size. When the coating fails, the burden on the cathodic protection system for corrosion prevention is increased, requiring an increase in electrical current density around the piles.

SUMMARY OF INSPECTION DATA

REFIT-1 STEEL PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
1-1	B	1b	13-11	A	1b
1-2	B	1b	13-13	A	1b
1-3	A	1c	13-15	A	1b
1-4	A	1c	14-6	A	1b
1-5	B	1c	14-7	A	1b
2-1	C	1b	14-8	A	1b
2-2	B	1c	14-9	A	1a
2-3	B	1c	14-10	A	1a
2-4	B	1c	15-6	A	1b
2-5	C	1c	15-7	A	1b
2-6	C	1c	15-8	A	1b
2-7	B	2c	15-9	A	1b
2-8	B	1b	15-10	A	1b
2-9	B	1b	15-11	A	1b
2-10	B	1b	20-7	A	1a
2-11	C	1b	21-3	A	1a
3-1	A	2b	22-3	A	1b
3-2	A	2b	23-7	A	1b
3-3	B	1b			
3-4	B	1b			
3-5	B	1b			
3-6	A	1b			
3-8	A	1c			
3-9	B	1c			
3-10	A	1b			
3-11	B	1b			
11-1	B	1a			
11-2	B	1a			
11-3	B	1a			
11-4	B	1b			
11-5	A	1a			
11-6	A	1b			
11-7	A	1b			
11-8	B	1b			
11-9	B	1b			
11-10	B	1b			
11-11	A	1b			
13-7	A	1b			
13-8	A	1b			
13-9	A	1b			

SUMMARY OF INSPECTION DATA

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
1-1	A	2b	5-5	A	3c
1-2	A	2b	5-6	A	3c
1-3	A	2b	5-7	A	3c
1-4	A	2b	5-8	A	3c
1-5	A	2b	6-1	A	3c
1-6	A	2b	6-2	A	3c
1-7	A	2b	6-3	A	3c
1-8	A	2b	6-4	A	3c
1-9	A	2b	6-5	A	3c
1-10	A	2b	6-6	A	3c
1-11	A	2b	6-7	A	3c
2-1	A	2c	6-8	A	3c
2-2	A	2c	7-1	A	3c
2-3	A	2c	7-2	A	3c
2-4	A	2c	7-3	A	3c
2-5	A	2c	7-4	A	3c
2-6	A	2c	7-5	A	3c
2-7	A	2c	7-6	A	3c
2-8	A	2c	7-7	A	3c
3-1	A	2c	7-8	A	3c
3-2	A	2c	8-1	A	3c
3-3	A	2c	8-2	A	3c
3-4	A	2c	8-3	A	3c
3-5	A	2c	8-4	A	3c
3-6	A	2c	8-5	A	3c
3-7	A	2c	8-6	A	3c
3-8	A	2c	8-7	A	3c
4-1	A	3c	8-8	A	3c
4-2	A	3c	9-1	A	3c
4-3	A	3c	9-2	A	3c
4-4	A	3c	9-3	A	3c
4-5	A	3c	9-4	A	3c
4-6	A	3c	9-5	A	3c
4-7	A	3c	9-6	A	3c
4-8	A	3c	9-7	A	3c
5-1	A	3c	9-8	A	3c
5-2	A	3c	10-1	A	3c
5-3	A	3c	10-2	A	3c
5-4	A	3c	10-3	A	3c

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
10-4	A	3c	14-5	A	2b
10-5	A	3c	14-6	A	2b
10-6	A	3c	14-7	A	1b
10-7	A	3c	14-8	A	1b
10-8	A	3c	14-9	A	1b
11-1	A	3c	14-10	A	1b
11-2	A	3c	14-11	A	1b
11-3	A	3c	15-1	A	2c
11-4	A	3c	15-2	A	2c
11-5	A	3c	15-3	A	2c
11-6	A	3c	15-4	A	2c
11-7	A	3c	15-5	A	2b
11-8	A	3c	15-6	A	2b
12-1	A	3c	15-7	A	2b
12-2	A	3c	15-8	A	1b
12-3	A	3c	15-9	A	1b
12-4	A	3c	15-10	A	1b
12-5	A	2c	15-11	A	1b
12-6	A	2c	16-1	A	2b
12-7	A	2c	16-2	A	2b
12-8	A	2c	16-3	A	2b
12-9	A	2b	16-4	A	2b
12-10	A	2b	16-5	A	2b
12-11	A	2b	16-6	A	2b
13-1	A	2c	16-7	A	2b
13-2	A	2c	16-8	A	2b
13-3	A	2c	16-9	A	2b
13-4	A	2c	16-10	A	2b
13-5	A	2c	16-11	A	2b
13-6	A	2c	17-1	A	2b
13-7	A	2c	17-2	A	2b
13-8	A	2c	17-3	A	2b
31-9	A	2c	17-4	A	2b
13-10	A	2c	17-5	A	2b
13-11	A	2c	17-6	A	2b
14-1	A	2c	17-7	A	2b
14-2	A	2c	17-8	A	2b
14-3	A	2c	17-9	A	2b
14-4	A	2c	17-10	A	2b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
17-11	A	2b	20-6	A	3c
18-1	A	2b	20-7	A	3c
18-2	A	2b	20-8	A	3c
18-3	A	2b	20-9	A	3c
18-4	A	2b	20-10	A	3c
18-5	A	2b	20-11	A	3c
18-6	A	2b	20-12	A	3c
18-7	A	2b	20-13	A	3c
18-8	A	2b	20-14	A	3c
18-9	A	2b	20-15	A	3c
18-10	A	2b	20-16	A	3c
18-11	A	2b	20-17	A	3c
19-1	A	2c	20-18	A	3c
19-2	A	2c	20-19	A	3c
19-3	A	3c	20-20	A	3c
19-4	A	3c	20-21	A	2c
19-5	A	3c	20-22	A	2c
19-6	A	3c	20-23	A	2c
19-7	A	3c	20-24	A	2c
19-8	A	3c	20-25	A	2c
19-9	A	3c	20-26	A	2c
19-10	A	3c	20-27	A	2b
19-11	A	3c	20-28	A	2b
19-12	A	3c	20-29	A	2b
19-13	A	3c	20-30	A	2b
19-14	A	3c	20-31	A	2b
19-15	A	3c	20-32	A	2b
19-16	A	3c	21-1	A	2c
19-17	A	2c	21-2	A	2c
19-18	A	2c	21-3	A	3c
19-19	A	2c	21-4	A	3c
19-20	A	2c	21-5	A	3c
19-21	A	2c	21-6	A	3c
19-22	A	2c	21-7	A	3c
20-1	A	2c	21-8	A	3c
20-2	A	2c	21-9	A	3c
20-3	A	2c	21-10	A	3c
20-4	A	3c	21-11	A	3c
20-5	A	3c	21-12	A	3c

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
21-13	A	3c	22-20	A	3c
21-14	A	3c	22-21	A	3c
21-15	A	3c	22-22	A	3c
21-16	A	3c	22-23	A	3c
21-17	A	3c	22-24	A	2c
21-18	A	3c	22-25	A	2c
21-19	A	3c	22-26	A	2c
21-20	A	3c	22-27	A	2c
21-21	A	3c	22-28	A	2c
21-22	A	3c	22-29	A	2b
21-23	A	2c	22-30	A	1b
21-24	A	2c	22-31	A	1b
21-25	A	2c	22-32	A	1b
21-26	A	2c	23-1	A	2b
21-27	A	2c	23-2	A	2b
21-28	A	2c	23-3	A	2b
21-29	A	2b	23-4	A	2b
21-30	A	2b	23-5	A	2c
21-31	A	2b	23-6	A	3c
21-32	A	2b	23-7	A	3c
22-1	A	2b	23-8	A	3c
22-2	A	2b	23-9	A	3c
22-3	A	2b	23-10	A	3c
22-4	A	2b	23-11	A	3c
22-5	A	2b	23-12	A	3c
22-6	A	3b	23-13	A	3c
22-7	A	3b	23-14	A	3c
22-8	A	3b	23-15	A	3c
22-9	A	3b	23-16	A	3c
22-10	A	3b	23-17	A	3c
22-11	A	3c	23-18	A	3c
22-12	A	3c	23-19	A	2c
22-13	A	3c	23-20	A	2c
22-14	A	3c	23-21	A	2c
22-15	A	3c	23-22	A	2c
22-16	A	3c	23-23	A	2c
22-17	B	3c	23-24	A	2c
22-18	A	3c	23-25	A	2b
22-19	A	3c	23-26	A	2b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
23-27	A	2b	25-1	A	1b
23-28	A	2b	25-2	A	2b
23-29	A	2b	25-3	A	2b
23-30	A	1b	25-4	A	2b
23-31	A	1b	25-5	A	2b
23-32	A	1b	25-6	A	2c
24-1	A	1b	25-7	A	2c
24-2	A	2b	25-8	A	2c
24-3	A	2b	25-9	A	2c
24-4	A	2b	25-10	A	3c
24-5	A	2b	25-11	A	3c
24-6	A	2b	25-12	A	3c
24-7	A	2b	25-13	A	2c
24-8	A	2b	25-14	A	2c
24-9	A	2b	25-15	A	2c
24-10	A	2c	25-16	A	2c
24-11	A	2c	25-17	B	2c
24-12	A	2c	25-18	A	2c
24-13	A	2c	25-19	B	2c
24-14	A	2c	25-20	A	2c
24-15	A	3c	25-21	A	1c
24-16	A	3c	25-22	A	1b
24-17	A	3c	26-1	A	1b
24-18	A	3c	26-2	B	2b
24-19	A	3c	26-3	A	2b
24-20	A	3c	26-4	A	2b
24-21	A	3c	26-5	A	2b
24-22	A	2c	26-6	A	2b
24-23	A	2c	26-7	A	2b
24-24	A	2c	26-8	A	2b
24-25	A	2c	26-9	A	2b
24-26	A	2c	26-10	A	2b
24-27	A	2c	26-11	A	2b
24-28	A	1c	26-12	A	1b
24-29	A	1c	26-13	A	1b
24-30	A	1b	26-14	A	1b
24-31	A	1b	27-1	A	1a
24-32	A	1b	27-2	A	3b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
27-3	A	3b	31-9	A	2b
27-4	A	2b	31-10	A	2b
27-5	A	2b	31-11	A	2b
27-6	A	2b	31-12	A	1b
27-7	A	2b	31-13	A	1b
27-8	A	2b	31-14	A	1b
27-9	A	2b	31-15	A	1b
27-10	A	2b	31-16	A	1b
27-11	A	1b	31-17	A	1b
28-1	A	2b	31-18	A	1b
28-2	A	2b	31-19	A	1b
28-3	A	2b	31-20	B	1b
28-4	A	2b	31-21	A	1b
28-5	A	2b	31-22	A	1b
28-6	A	2b	31-23	A	1b
28-7	A	2b	31-24	B	1b
28-8	A	2b	32-1	A	1b
29-9	A	1b	32-2	A	1b
29-10	A	1b	32-3	A	1b
29-11	A	1b	32-4	B	1b
30-1	A	2b	32-5	A	1b
30-2	A	2b	32-6	A	1b
30-3	A	2b	32-7	A	1b
30-4	A	2b	33-1	A	1b
30-5	A	2b	33-2	A	1b
30-6	A	2b	33-3	A	1b
30-7	A	2b	33-4	B	1b
30-8	A	2b	33-5	A	1b
30-9	A	2b	33-6	A	1b
30-10	A	2b	33-7	A	1b
30-11	A	2b	34-1	A	1b
31-1	A	2b	34-2	A	1b
31-2	B	3b	34-3	A	1b
31-3	A	3b	34-4	B	1b
31-4	A	3b	34-5	A	1b
31-5	A	3b	34-6	A	1b
31-6	A	3b	34-7	A	1b
31-7	A	3b	34-8	A	1b
31-8	A	3b	34-9	A	1b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
34-10	A	2b	37-4	A	1b
34-11	A	2b	37-5	A	1b
34-12	A	1b	37-6	A	1b
34-13	A	1b	37-7	A	1b
34-14	A	1b	37-8	A	1b
34-15	A	1b	37-9	A	1b
34-16	A	1b	37-10	A	1b
34-17	A	1b	37-11	A	1b
34-18	A	1b	38-1	A	2b
34-19	A	1b	38-2	A	2b
34-20	A	1b	38-3	A	2b
34-21	A	1b	38-4	A	1b
34-22	A	1b	38-5	A	1b
34-23	A	1b	38-6	A	1b
34-24	A	1b	38-7	A	1b
35-1	A	2b	38-8	A	1b
35-2	A	2b	38-9	A	1b
35-3	A	1b	38-10	A	1b
35-4	A	1b	38-11	A	1b
35-5	A	1b	38-12	A	1b
35-6	A	1b	38-13	A	1b
35-7	A	1b	39-1	A	2b
35-8	A	1b	39-2	A	2b
35-9	A	1b	39-3	A	2b
35-10	A	1b	39-4	A	2b
35-11	A	1b	39-5	A	2b
36-1	A	1b	39-6	A	1b
36-2	A	1b	39-7	A	1b
36-3	A	1b	39-8	A	1b
36-4	A	1b	39-9	B	1b
36-5	A	1b	39-10	A	1b
36-6	A	1b	39-11	A	1b
36-7	A	1b	39-12	A	1b
36-8	A	1b	39-13	A	1b
36-9	A	1b	40-1	A	3b
36-10	A	1b	40-2	A	3b
36-11	A	1b	40-3	A	3b
37-1	A	1b	40-4	A	3b
37-2	A	1b	40-5	A	3b
37-3	A	1b	40-6	A	3b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
40-7	A	3b	44-10	A	2b
40-8	A	3b	44-11	A	2b
40-9	A	3b	44-12	A	2b
41-1	A	3b	44-13	A	2b
41-2	A	3b	45-1	A	2b
41-3	A	3b	45-2	A	2b
41-4	A	3b	45-3	A	1b
41-5	A	3b	45-4	A	1b
41-6	A	3b	45-5	A	1b
41-7	A	3b	45-6	A	1b
41-8	A	3b	45-7	A	1b
42-1	A	3b	45-8	A	1b
42-2	A	3b	45-9	A	1b
42-3	A	3b	45-10	A	1b
42-4	A	3b	45-11	A	1a
42-5	A	3b	45-12	A	1a
42-6	A	3b	45-13	A	1a
42-7	A	3b	45-14	A	1c
42-8	A	3b	46-1	A	1b
42-9	A	3b	46-2	A	1b
43-1	A	2b	46-3	A	1b
43-2	A	2b	46-4	A	1a
43-3	A	2b	46-5	A	1b
43-4	A	2b	46-6	A	1b
43-5	A	2b	46-7	A	1b
43-6	A	2b	46-8	A	1b
43-7	A	2b	46-9	A	1b
43-8	A	2b	46-10	A	1b
43-9	A	2b	46-11	A	1b
43-10	A	2b	47-1	A	1a
43-11	A	2b	47-2	A	1b
44-1	A	2b	47-3	A	1b
44-2	A	2b	47-4	A	1b
44-3	A	2b	47-5	A	1b
44-4	A	2b	47-6	A	1b
44-5	A	2b	48-1	A	1a
44-6	A	2b	48-2	A	1b
44-7	A	2b	48-3	A	1b
44-8	A	2b	48-4	A	1b
44-9	A	2b	48-5	A	1b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
49-5	A	1b	51-14	A	2b
49-6	A	1b	51-15	A	2b
49-7	A	1b	51-16	A	2b
49-8	A	1b	51-17	A	2b
49-9	A	1a	51-18	A	2b
49-10	A	1b	51-19	A	2b
49-11	A	1b	52-1	A	1b
49-12	A	1b	52-2	A	1b
50-1	A	1b	52-3	A	1b
50-2	A	1b	52-4	A	1b
50-3	A	1b	52-5	A	1b
50-4	A	1b	52-6	A	1b
50-5	A	1b	52-7	A	1b
50-6	A	1b	52-8	A	1b
50-7	A	1b	52-9	A	2b
50-8	A	2b	52-10	A	2b
50-9	A	2b	52-11	A	2b
50-10	A	2b	52-12	A	2b
50-11	A	2b	52-13	A	2b
50-12	A	2b	52-14	A	2b
50-13	A	2b	52-15	A	2b
50-14	A	2b	52-16	A	2b
50-15	A	2b	52-17	A	2b
50-16	A	2b	52-18	A	2b
50-17	A	2b	52-19	A	2b
50-18	A	2b	53-1	A	1b
50-19	A	2b	53-2	A	1b
50-20	A	2b	53-3	A	1b
51-1	A	2b	53-4	A	1b
51-2	A	1b	53-5	A	2b
51-3	A	1b	53-6	A	2b
51-4	A	1b	53-7	A	2b
51-5	A	1b	53-8	A	2b
51-6	A	1b	53-9	A	2b
51-7	A	1b	53-10	A	2b
51-8	A	2b	53-11	A	2b
51-9	A	2b	53-12	A	2b
51-10	A	2b	53-13	A	2b
51-11	A	2b	53-14	A	2b
51-12	A	2b	53-15	A	2b
51-13	A	2b	53-16	A	2b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
53-17	A	2b	55-19	A	2b
53-18	A	2b	56-1	A	1a
53-19	A	2b	56-2	A	1a
54-1	A	1b	56-3	A	1b
54-2	A	1b	56-4	A	1b
54-3	A	1b	56-6	A	2b
54-4	A	1b	56-7	A	2b
54-5	A	1b	56-8	A	2b
54-6	A	1b	56-9	A	2b
54-7	A	2b	56-10	A	2b
54-8	A	2b	56-11	A	2b
54-9	A	2b	56-12	A	2b
54-10	A	2b	56-13	A	2b
54-11	A	2b	56-14	A	2b
54-12	A	2b	56-15	A	2b
54-13	A	2b	56-16	A	2b
54-14	A	2b	56-17	A	2b
54-15	A	2b	56-18	A	2b
54-16	A	2b	56-19	A	2b
54-17	A	2b	57-1	A	2b
54-18	A	2b	57-2	A	2b
54-19	A	2b	57-3	A	2b
55-1	A	1b	57-4	A	2b
55-2	A	1b	57-5	A	2b
55-3	A	1b	57-6	A	2b
55-4	A	2b	57-7	A	2b
55-5	A	1b	57-8	A	2b
55-6	A	2b	57-9	A	2b
55-7	A	2b	57-10	A	2b
55-8	A	2b	57-11	A	2b
55-9	A	2b	57-12	A	2b
55-10	A	2b	57-13	A	2b
55-11	A	2b	57-14	A	2b
55-12	A	2b	57-15	A	2b
55-13	A	2b	57-16	A	2b
55-14	A	2b	57-17	A	2b
55-15	A	2b	57-18	A	2b
55-16	A	2b	57-19	A	2b
55-17	A	2b	58-1	A	1b
55-18	A	2b	58-2	A	1b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
58-3	A	1b	60-5	A	2b
58-4	A	1b	60-6	A	2b
58-5	A	1b	60-7	A	2b
58-6	A	1b	60-8	A	2b
58-7	A	2b	60-9	A	2b
58-8	A	2b	60-10	A	2b
58-9	A	2b	60-11	A	2b
58-10	A	2b	60-12	A	2b
58-11	A	2b	60-13	A	2b
58-12	A	2b	60-14	A	2b
58-13	A	2b	60-15	A	2b
58-14	A	2b	60-16	A	2b
58-15	A	2b	60-17	A	2b
58-16	A	2b	60-18	A	2b
58-17	A	2b	60-19	A	2b
58-18	A	2b	60-20	A	2b
58-19	A	2b	60-21	A	2b
59-1	A	2b	60-22	A	2b
59-2	A	2b	60-23	A	2b
59-3	A	2b	60-24	A	2b
59-4	A	2b	60-25	A	2b
59-5	A	2b	61-1	A	1b
59-6	A	2b	61-2	A	1b
59-7	A	2b	61-3	A	1b
59-8	A	1b	61-4	A	2b
59-9	A	1b	61-5	A	2b
59-10	A	1b	61-6	A	2b
59-11	A	1b	61-7	A	2b
59-12	A	1b	61-8	A	2b
59-13	A	1b	61-9	A	2b
59-14	A	1b	61-10	A	2b
59-15	A	1b	61-11	A	2b
59-16	A	1b	61-12	A	2b
59-17	A	1b	61-13	A	2b
59-18	A	1b	61-14	A	2b
59-19	A	1b	61-15	A	3b
60-1	A	2b	61-16	A	3b
60-2	A	2b	61-17	A	2b
60-3	A	2b	61-18	A	2b
60-4	A	2b	61-19	A	2b

REFIT-1 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
61-20	A	2b	62-20	A	1b
61-21	A	2b	62-21	A	1b
61-22	A	2b	62-22	A	1b
61-23	A	2b	63-1	A	1a
61-24	A	2b	63-2	A	1b
62-1	A	1a	63-3	A	1b
62-2	A	1a	63-4	A	1b
62-3	A	1b	63-5	A	1b
62-4	A	1b	63-6	A	1b
62-5	A	2b	63-7	A	1b
62-6	A	2b	63-8	A	1b
62-7	A	2b	63-9	A	1b
62-8	A	2b	63-10	A	1b
62-9	A	2b	63-11	A	1b
62-10	A	2b	63-12	A	1b
62-11	A	2b	63-13	A	1b
62-12	A	1b	63-14	A	1b
62-13	A	1b	63-15	A	1b
62-14	A	1b	63-16	A	1b
62-15	A	1b	63-17	A	1b
62-16	A	1b	63-18	A	1b
62-17	A	1b	63-19	A	1b
62-18	A	1b	63-20	A	1b
62-19	A	1b	63-21	A	1b

SUMMARY OF INSPECTION DATA

REFIT-2 STEEL PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
A-1	A	2b	L-9	A	1a
A-2	A	2b	L-10	A	1a
A-3	A	2b	L-11	A	1a
A-4	A	2b	P-1	A	1b
A-5	A	2b	P-2	A	1b
A-6	A	2b	P-3	A	1b
B-1	A	1b	P-4	A	1b
B-2	C	1c	P-5	A	1b
B-3	A	1b	P-6	A	1b
B-4	A	1b	P-7	A	1b
B-5	A	1b	P-8	A	1b
B-6	A	1b	P-9	A	1b
B-7	A	1b	P-10	A	1b
B-8	A	1b	P-11	A	1b
B-9	A	1b	R-8	A	1b
B-10	A	1b	R-11	B	1b
B-11	A	1b	S-4	A	1b
B-12	A	1b	S-5	A	1b
B-13	A	1a	S-6	A	1b
B-14	A	1a	S-7	A	1b
B-15	A	1a	S-8	A	1b
H-1	A	1b	S-9	A	1b
H-2	A	1b	S-10	A	1b
H-3	A	1b	U-3	A	1b
H-4	A	1b	U-4	C	1b
H-5	A	1b	U-5	A	1b
H-6	A	1b	U-6	B	1b
H-7	A	1b	U-7	B	1b
H-8	A	1c	U-8	A	1b
H-9	A	1b	U-9	A	1b
H-10	A	1b	U-10	A	1b
H-11	A	1b	U-11	A	1b
L-1	A	1a	U-12	A	1b
L-2	A	1a			
L-3	A	1a			
L-4	A	1a			
L-5	A	1a			
L-6	A	1a			
L-7	A	1a			
L-8	A	1a			

SUMMARY OF INSPECTION DATA

REFIT-2 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
1-1	A	1a	3-1	A	1a
1-2	A	1a	3-2	A	1a
1-3	A	1a	3-3	A	1a
1-4	A	1b	3-4	A	1c
1-5	A	1b	3-5	A	1c
1-6	A	1b	3-6	A	1b
1-7	A	1b	3-7	A	1b
1-8	A	1b	3-8	A	1b
1-9	A	1b	3-9	A	1b
1-10	A	2b	3-10	A	1b
1-11	A	1b	3-11	A	2b
1-12	A	2b	3-12	A	2b
1-13	A	2b	3-13	A	2c
1-14	A	2c	3-14	A	2c
1-15	A	2b	3-15	A	2c
1-16	A	2c	3-16	A	2c
1-17	A	2b	3-17	A	2c
1-18	A	2c	3-18	A	2c
1-19	A	2c	3-19	A	2c
2-1	A	1a	4-1	A	1a
2-2	A	1a	4-2	A	1a
2-3	A	1c	4-3	A	1b
2-4	A	1a	4-4	A	1b
2-5	A	1a	4-5	A	1b
2-6	A	1b	4-6	A	1b
2-7	A	1b	4-7	A	1b
2-8	A	1b	4-8	A	1b
2-9	A	1b	4-9	A	1b
2-10	A	2b	4-10	A	2b
2-11	A	2b	4-11	A	2c
2-12	A	2c	4-12	A	2c
2-13	A	2c	4-13	A	2c
2-14	A	2c	4-14	A	2c
2-15	A	2c	4-15	A	2c
2-16	A	2c	4-16	A	2c
2-17	A	2c	4-17	A	2c
2-18	A	2c	4-18	A	2c
2-19	A	2c	4-19	A	2c

REFIT-2 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
5-1	A	1a	7-1	A	1b
5-2	A	1a	7-2	A	1b
5-3	A	1a	7-3	A	2b
5-4	A	1b	7-4	A	2b
5-5	A	1b	7-5	A	2b
5-6	A	2b	7-6	A	2b
5-7	A	2b	7-7	A	2b
5-8	A	2b	7-8	A	2b
5-9	A	2b	7-9	A	2b
5-10	A	2b	7-10	A	2b
5-11	A	2b	7-11	A	2b
5-12	A	2b	7-12	A	3b
5-13	A	2c	7-13	A	3b
5-14	A	2c	7-14	A	3b
5-15	A	2c	7-15	A	3b
5-16	A	2c	7-16	A	3c
5-17	A	3c	7-17	A	3c
5-18	A	3c	7-18	A	3c
5-19	A	3c	7-19	A	3c
6-1	A	1b	8-]	A	1b
6-2	A	1b	8-2	A	2b
6-3	A	2b	8-3	A	2b
6-4	A	2b	8-4	A	2b
6-5	A	2b	8-5	A	2b
6-6	A	2b	8-6	A	2b
6-7	A	2b	8-7	A	2b
6-8	A	2b	8-8	A	2b
6-9	A	2b	8-9	A	2b
6-10	A	2b	8-10	A	2b
6-11	A	2b	8-11	A	2b
6-12	A	2b	8-12	A	2b
6-13	A	2c	8-13	A	2c
6-14	A	2c	8-14	A	3c
6-15	A	2c	8-15	A	3c
6-16	A	2c	8-16	A	3c
6-17	A	2c	8-17	A	3c
6-18	A	2c	8-18	A	3c
6-19	A	2c	8-19	A	3c

REFIT-2 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
9-1	A	1b	10-21	A	3c
9-2	A	1b	11-1	A	1b
9-3	A	1b	11-2	A	1b
9-4	A	2b	11-3	A	1b
9-5	A	2b	11-4	A	1b
9-6	A	2b	11-5	A	1b
9-7	A	2b	11-6	A	1b
9-8	A	2b	11-7	A	1b
9-9	A	2b	11-8	A	1b
9-10	A	2b	11-9	A	1b
9-11	A	2b	11-10	A	1b
9-12	A	2b	11-11	A	1b
9-13	A	2c	11-12	A	1b
9-14	A	3c	11-13	A	1b
9-15	A	3c	11-14	A	1b
9-16	A	3c	12-1	A	2b
9-17	A	3c	13-1	A	1b
9-18	A	3c	13-2	A	1b
9-19	A	3c	13-3	A	1b
10-1	A	1b	13-4	A	1b
10-2	A	1b	13-5	A	1b
10-3	A	1b	13-6	A	1b
10-4	A	2b	14-1	A	1b
10-5	A	2b	14-2	A	1b
10-6	A	2b	14-3	A	1b
10-7	A	3b	14-4	A	1b
10-8	A	2b	14-5	A	1b
10-9	A	2b	14-6	A	1b
10-10	A	2b	14-7	A	1b
10-11	A	2b	14-8	A	2b
10-12	A	2b	14-9	A	2b
10-13	A	3b	14-10	A	2b
10-14	A	3c	14-11	A	2b
10-15	A	3c	15-1	A	2b
10-16	A	3c	15-2	A	3c
10-17	A	3c	15-3	A	3c
10-18	A	3c	15-4	A	3c
10-19	A	3c	15-5	A	3c
10-20	A	3c	15-6	A	3c

REFIT-2 CONCRETE PILES

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
15-7	A	2b	19-9	A	2c
15-8	A	2b	20-1	A	2c
15-9	A	2b	20-2	A	2c
15-10	A	2b	20-3	A	2c
15-11	A	2b	20-4	A	2b
15-12	A	2b	20-5	A	2b
15-13	A	3c	20-6	A	2c
16-1	A	2b	20-7	A	2c
17-1	A	2b	20-8	A	2c
17-2	A	2b	21-1	A	2c
17-3	A	2b	21-2	A	2c
17-4	A	2b	21-3	A	2c
17-5	A	2b	21-4	A	2c
17-6	A	2b	21-5	A	2b
17-7	A	2b	21-6	A	2c
17-8	A	2c	22-1	A	2c
17-9	A	2c	22-2	A	2c
17-10	A	2c	22-3	A	2c
17-11	A	2c	22-4	A	2c
17-12	A	2c	22-5	A	2c
18-1	A	2b	23-1	A	2c
18-2	A	2b	23-2	A	2c
18-3	A	2c	23-3	A	2c
18-4	A	2c	23-4	A	2c
18-5	A	2c	23-5	A	2c
18-6	A	2c	24-1	A	2c
18-7	A	2c	24-2	A	2c
18-8	A	2c	24-3	A	2c
18-9	A	2c	24-4	A	2c
18-10	A	2c	24-5	A	2c
18-11	A	2c	25-1	A	2c
19-1	A	2c	25-2	A	2c
19-2	A	2c	25-3	A	2c
19-3	A	2c	25-4	A	2c
19-4	A	2c	25-5	A	2c
19-5	A	2c	26-1	A	2c
19-6	A	2c	26-2	A	2c
19-7	A	2c	26-3	A	2c
19-8	A	2c	26-4	A	2c

APPROACH TRESTLE REFIT-1

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
0-1	A	1c	10-1	A	1b
0-2	A	1c	10-2	A	1b
0-3	A	1c	10-3	A	1b
0-4	A	1c	10-4	A	1b
1-1	A	1b	11-1	A	1b
1-2	A	1b	11-2	A	1b
1-3	A	1b	11-3	A	1b
1-4	A	1b	11-4	A	1b
2-1	A	1b	12-1	A	1b
2-2	A	1b	12-2	A	1b
2-3	A	1b	12-3	A	1b
2-4	A	1b	12-4	A	1b
3-1	A	1b	13-1	A	1b
3-2	A	1b	13-2	A	1b
3-3	A	1a	13-3	A	1b
3-4	A	1a	13-4	A	1b
4-1	A	1a	14-1	A	1b
4-2	A	1a	14-2	A	1b
4-3	A	1a	14-3	A	1b
4-4	A	1a	14-4	A	1b
4-5	A	1a	15-1	A	1b
5-1	A	1b	15-2	A	1b
5-2	A	1b	15-3	A	1b
5-3	A	1b	15-4	A	1b
5-4	A	1b	16-1	A	1b
5-5	A	1b	16-2	A	1b
6-1	B	1b	16-3	A	1b
6-2	A	1b	16-4	A	1b
6-3	A	1b	17-1	A	1b
6-4	A	1b	17-2	A	1b
7-1	A	1b	17-3	A	1b
7-2	A	1b	17-4	A	1b
7-3	A	1b	18-1	A	1c
7-4	A	1b	18-2	A	1c
8-1	A	1b	18-3	A	1c
8-2	A	1b	18-4	A	1c
8-3	A	1b	19-1	A	1c
8-4	A	1b	19-2	A	1c
9-1	A	1b	19-3	A	1c
9-2	A	1b	19-4	A	1c
9-3	A	1b	20-1	A	1c
9-4	A	1b	20-2	A	1c

APPROACH TRESTLE REFIT-1

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
20-3	A	1c	30-3	A	1c
20-4	A	1c	30-4	A	1c
21-1	A	1c	31-1	A	1c
21-2	A	1c	31-2	A	1c
21-3	A	1c	31-3	A	1c
21-4	A	1c	31-4	A	1c
22-1	A	1c	32-1	A	1c
22-2	A	1c	32-2	A	1c
22-3	A	1c	32-3	A	1c
22-4	A	1c	32-4	A	1c
23-1	A	1c	33-1	A	1c
23-2	A	1c	33-2	A	1c
23-3	A	1c	33-3	A	1c
23-4	A	1c	33-4	A	1c
24-1	A	1c	34-1	A	1c
24-2	A	1c	34-2	A	1c
24-3	A	1c	34-3	A	1c
24-4	A	1c	34-4	A	1c
25-1	A	1c	35-1	A	1c
25-2	A	1c	35-2	A	1c
25-3	A	1c	35-3	A	1c
25-4	A	1c	35-4	A	1c
26-1	A	1c	36-1	A	1c
26-2	A	1c	36-2	A	1c
26-3	A	1c	36-3	A	1c
26-4	A	1c	36-4	A	1c
27-1	A	1c	37-1	A	-
27-2	A	1c	37-2	A	-
27-3	A	1c	37-3	A	-
27-4	A	1c	37-4	A	-
28-1	A	1c	38-1	A	-
28-2	A	1c	38-2	A	-
28-3	A	1c	38-3	A	-
28-4	A	1c	38-4	A	-
29-1	A	1c	39-1	A	-
29-2	A	1c	39-2	A	-
29-3	A	1c	39-3	A	-
29-4	A	1c	39-4	A	-
30-1	A	1c	40-1	A	-
30-2	A	1c	40-2	A	-
			40-3	A	-
			40-4	A	-

KEY TO DATA PAGES

CONDITION

A-No damage, deterioration or structural problems noted

B-Minor spalls, rough, uneven surface

C-Large spalls, cracks exposed rebar.

D-Severely damaged pile

E-Splices, spacers.

MARINE GROWTH

1-Heavy coverage (80-100% area)

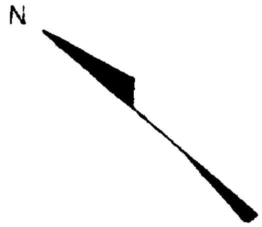
2-Medium coverage (60-80% area)

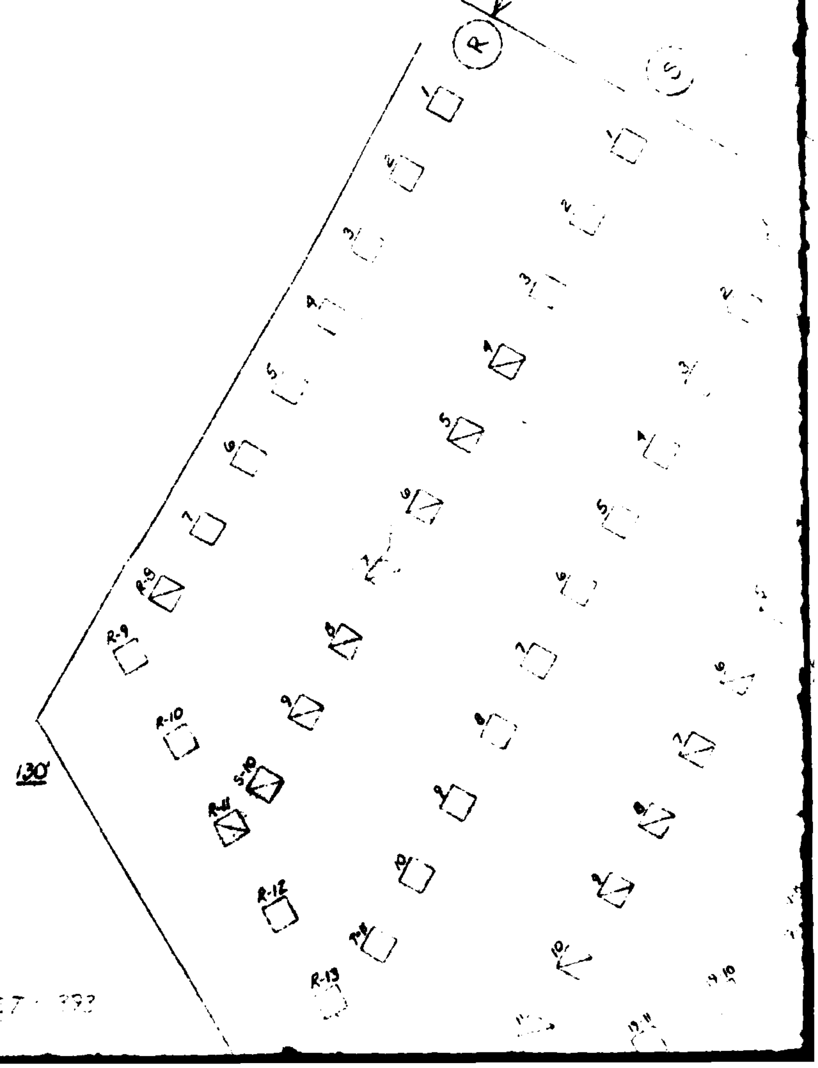
3-Light coverage (less than 60% area)

a-Thick coverage (1 1/2" or greater)

b-Average coverage (3/4" to 1 1/2")

c-Thin coverage (3/4" or less)





KEY

SUPPORT PILE

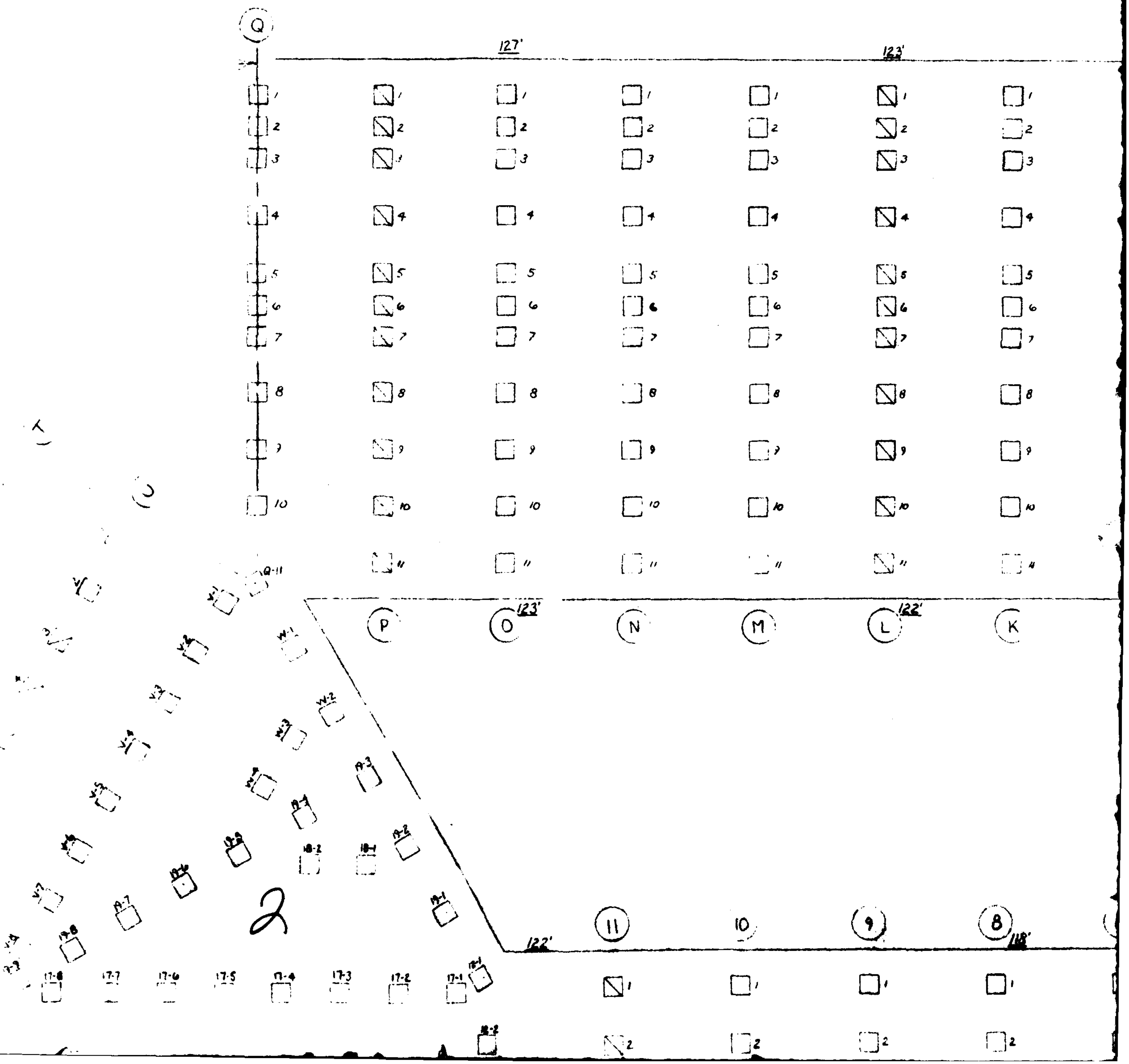
PILE INSPECTED 6/8. CONDITION GOOD

DAMAGED PILE

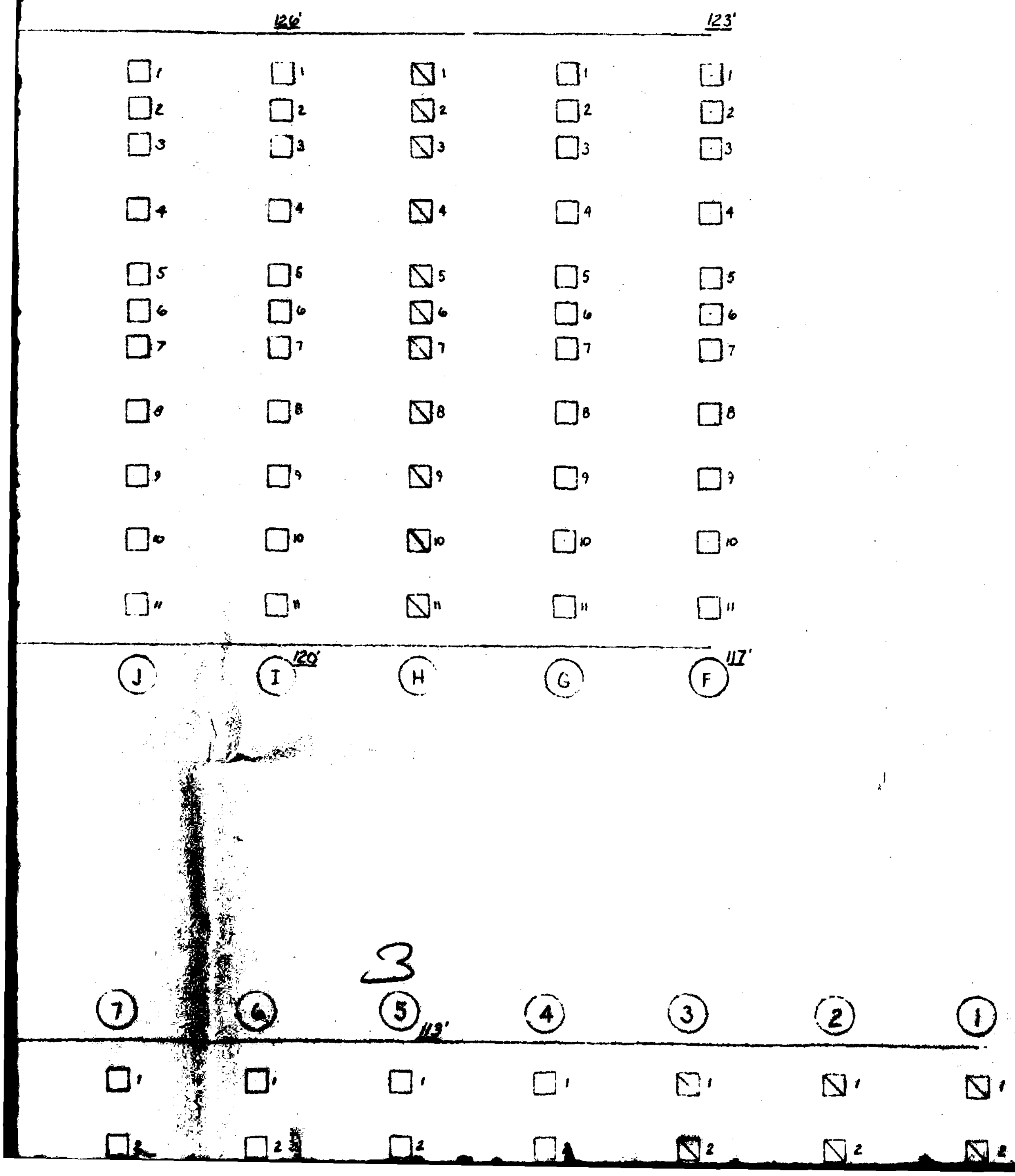
BENT DESIGATION

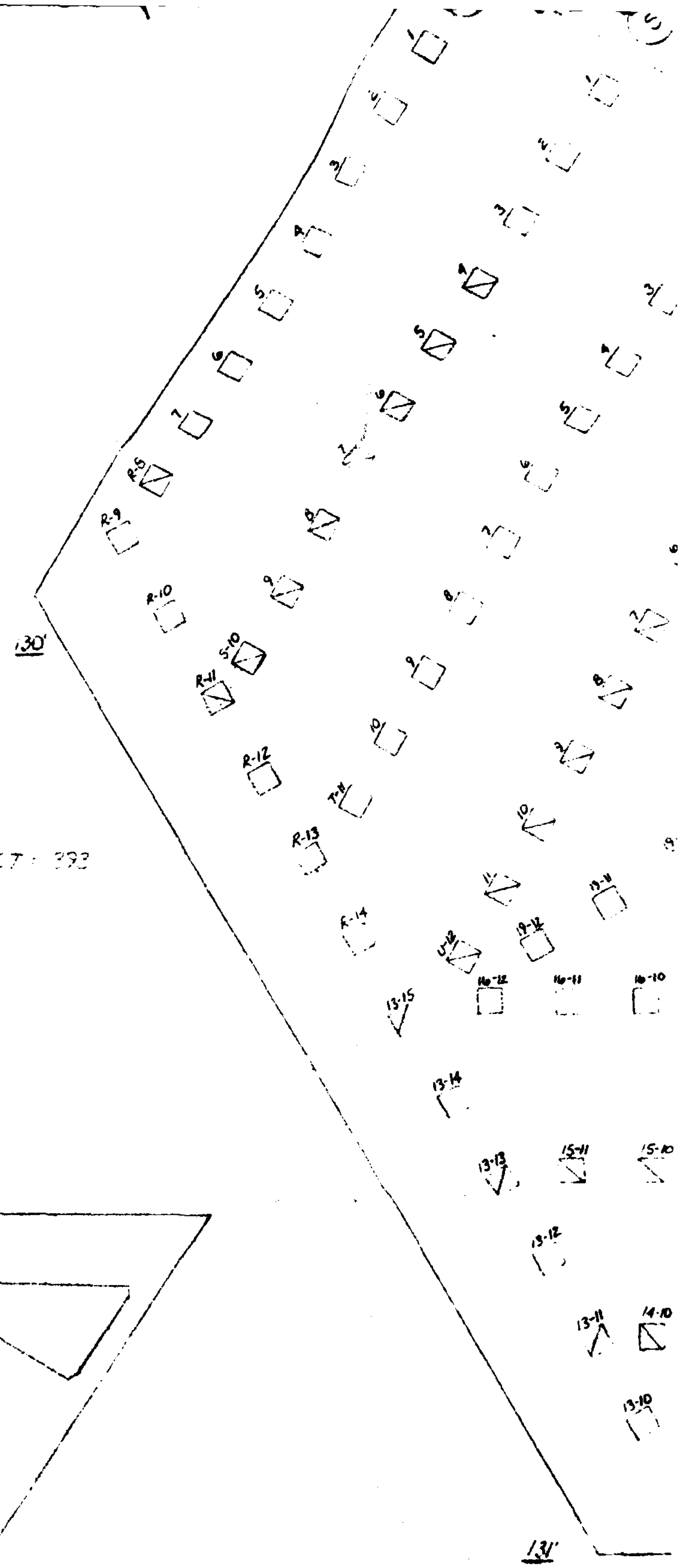
SOUNDINGS (FEET BASED ON MSL)

TOTAL STEEL PILES THIS SHEET : [illegible]



Q
127'
123'
P
O
N
M
L
K
123'
122'
Q-11
11
10
9
8
122'
118'
17-8
17-7
17-6
17-5
17-4
17-3
17-2
17-1
18-1
18-2
19-1
19-2
2


126'
123'
J
I
H
G
F
120'
117'
3
7
6
5
4
3
2
1
113'
1
2
3
4
5
6
7
8
9
10
11



KEY

SUPPORT PILE

PILE INSPECTED 6/8, CONDITION GOOD

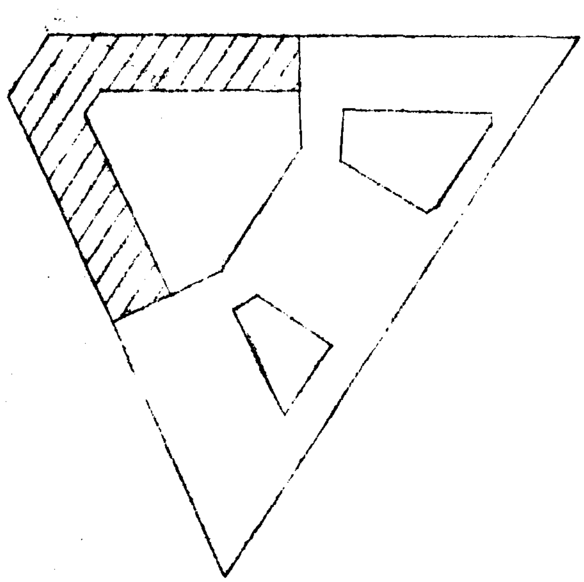
DAMAGED PILE

BENT DESIGATION

75' SOUNDINGS (FEET, BASED ON MSL)

TOTAL STEEL PILES THIS SHEET: 393

TOTAL INSPECTED: 96



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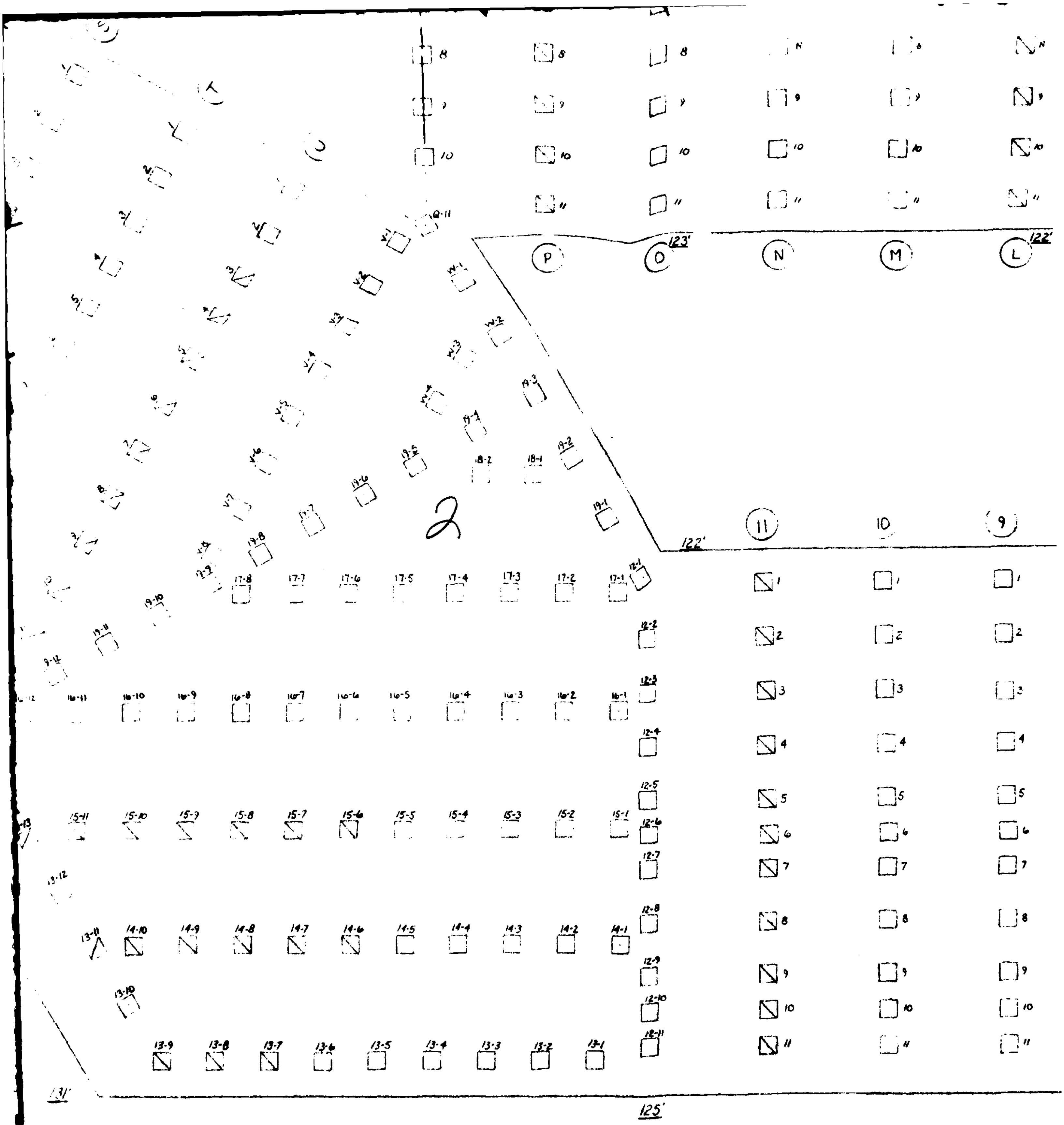
4



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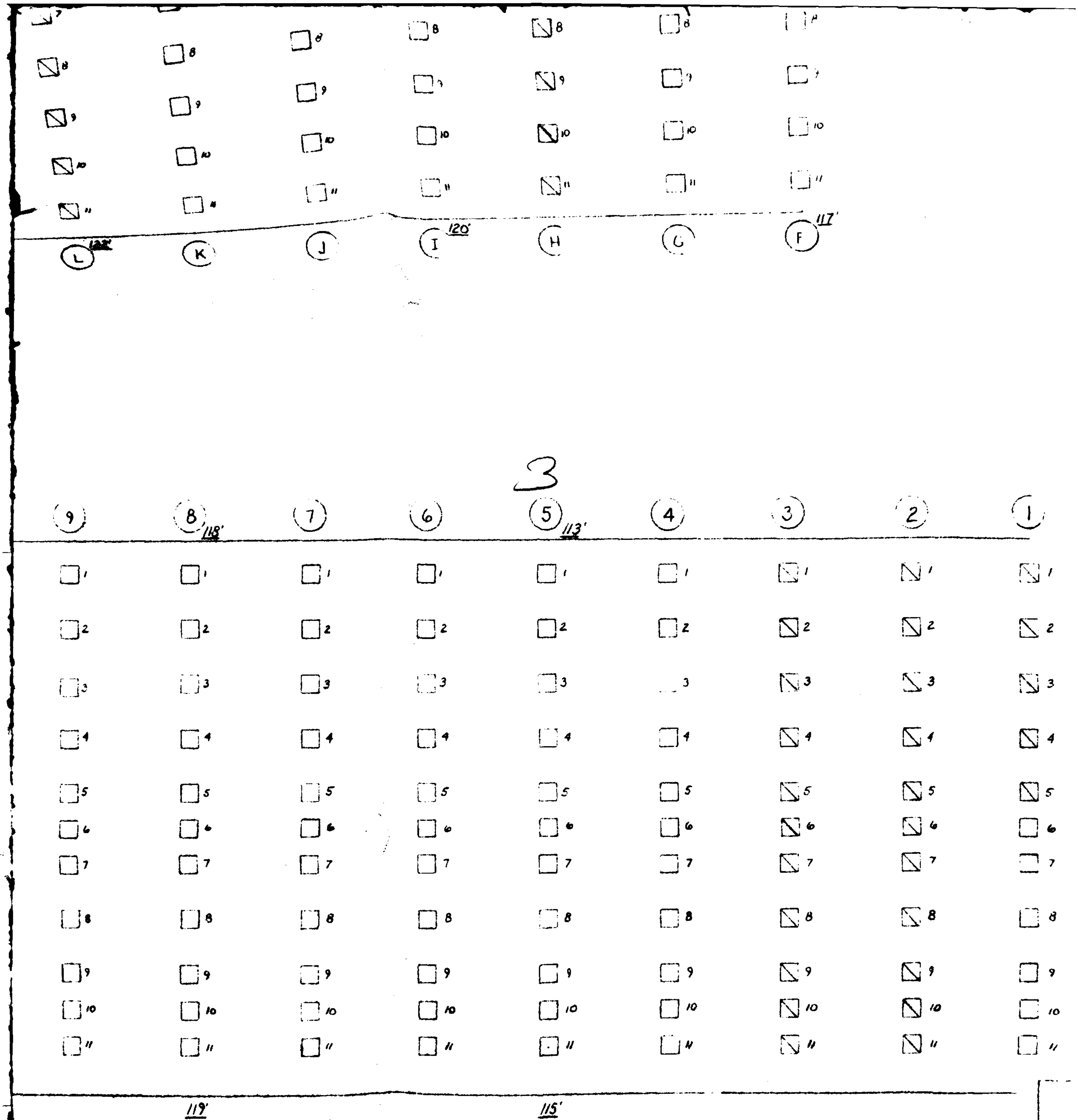


PILE P...

TRIDENT REFIT FACI...

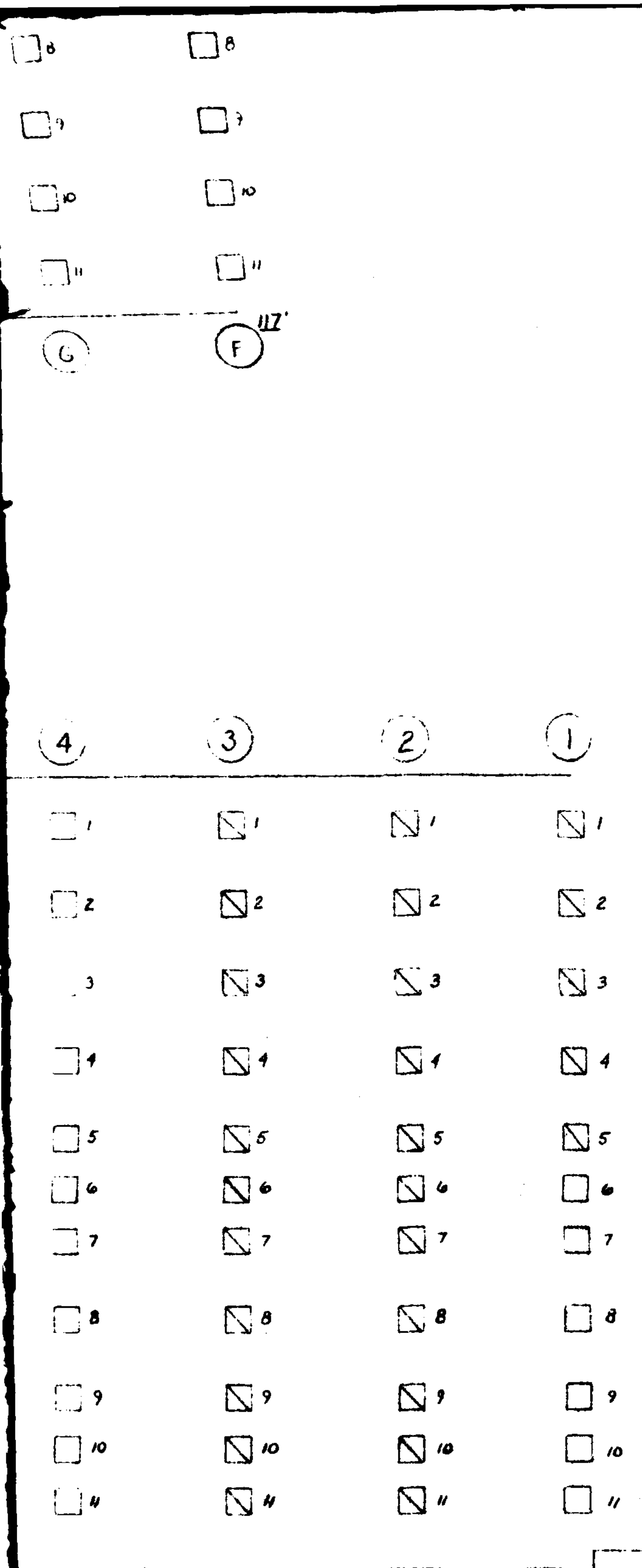
UNDERWATER FACILITY ASSES...

CHESDIV, NAVFACENGCOM

CONTRACT N-62477-80-C...

WISWELL, INC SOUTHPORT...

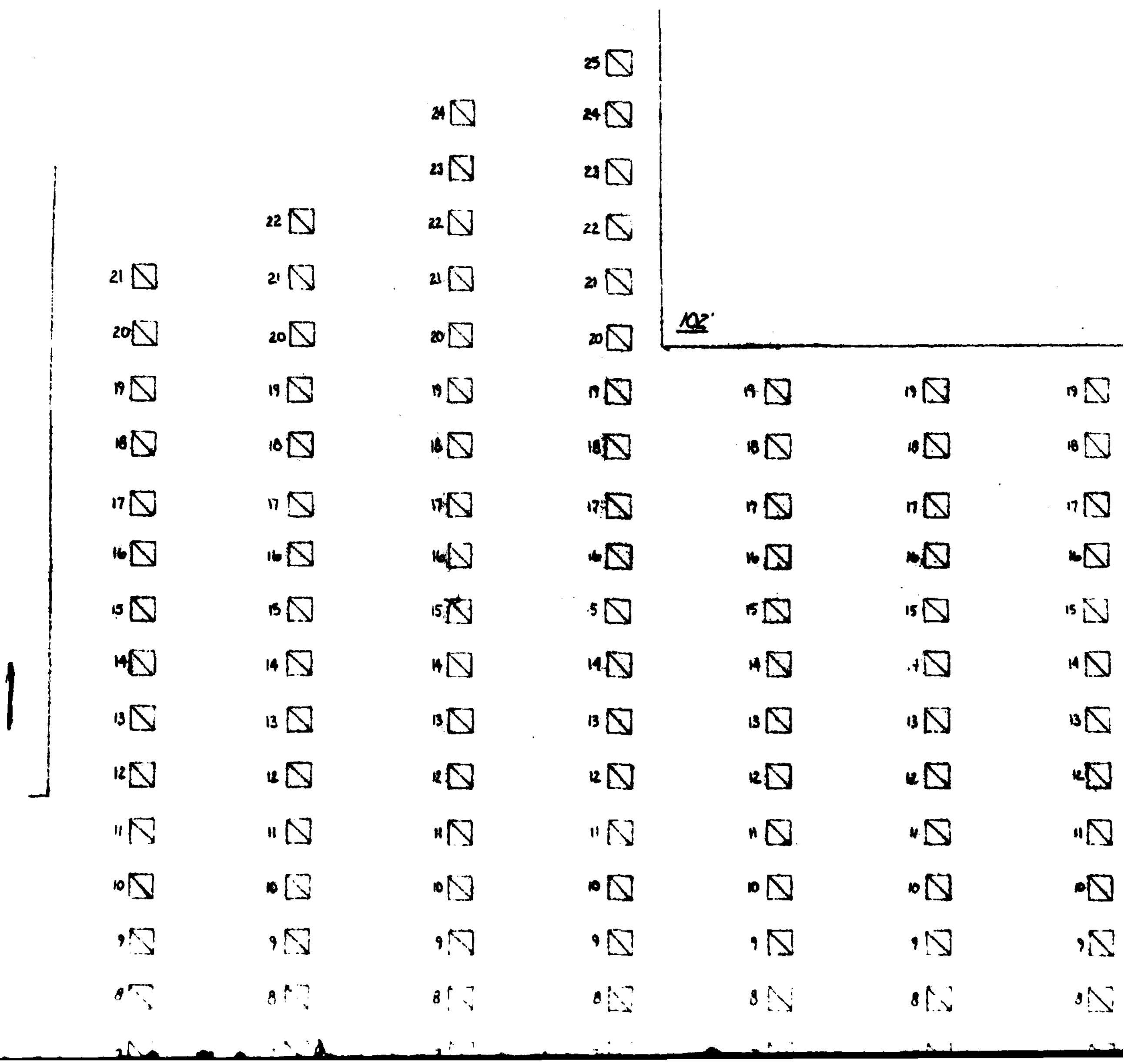
6

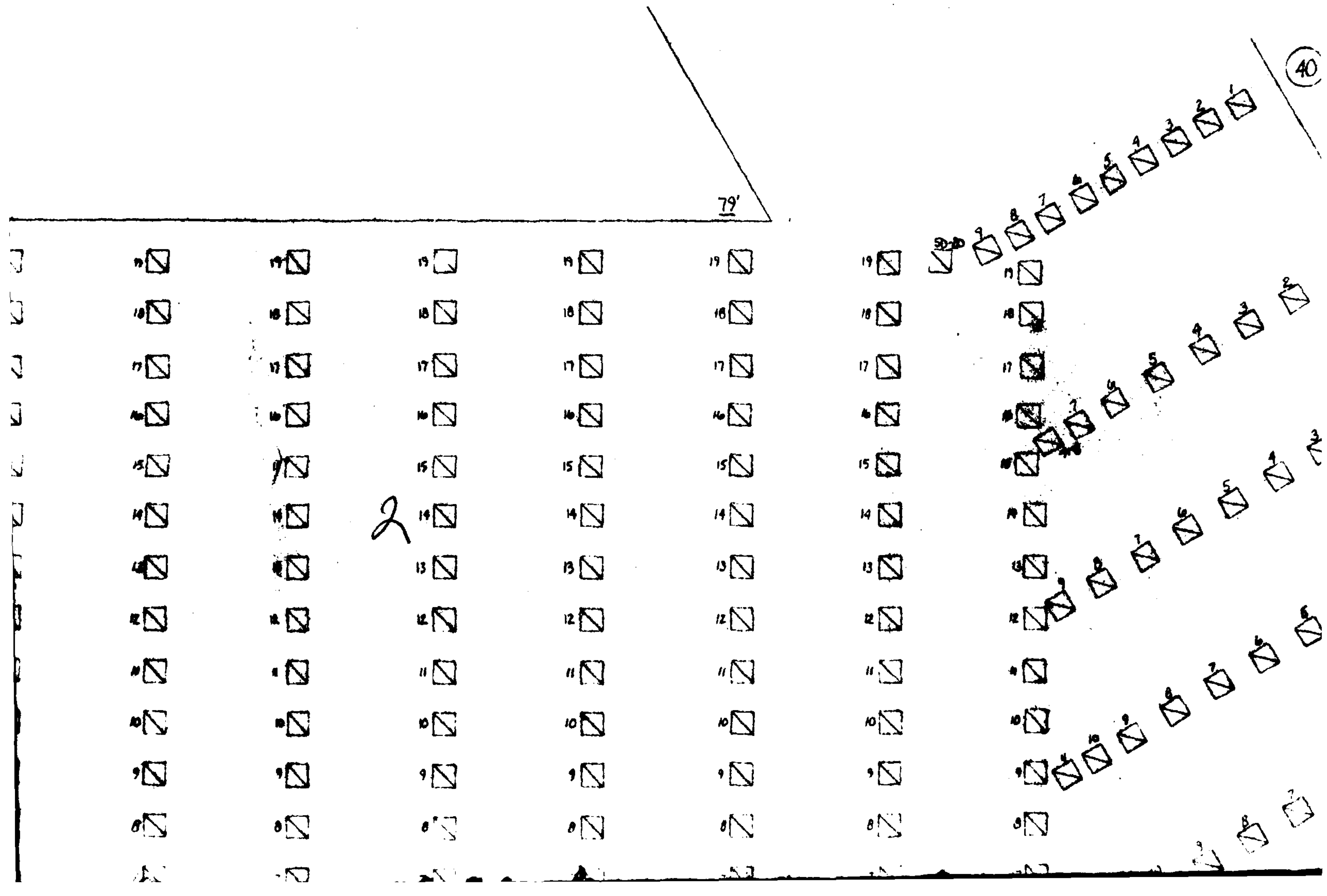


PILE PLAN - REFIT 1 & 2
TRIDENT REFIT FACILITY, BANGOR, WASHINGTON

UNDERWATER FACILITY ASSESSMENT CHESDIV, NAVFACENGCOM CONTRACT N-62477 80-C-0233 WISWELL, INC SOUTHPORT, CT	DATE 7/17/81 SCALE NOT TO SCALE DRAWN BY BMS APPROVED BY RHJ REVISED 9/6/81

7


102'

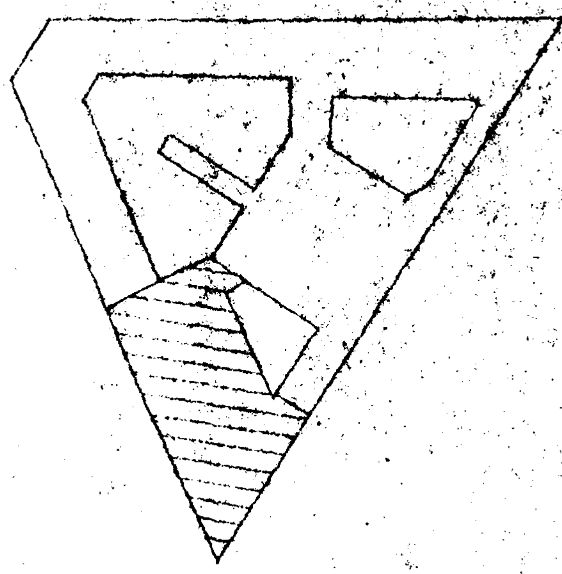

79'
40
2

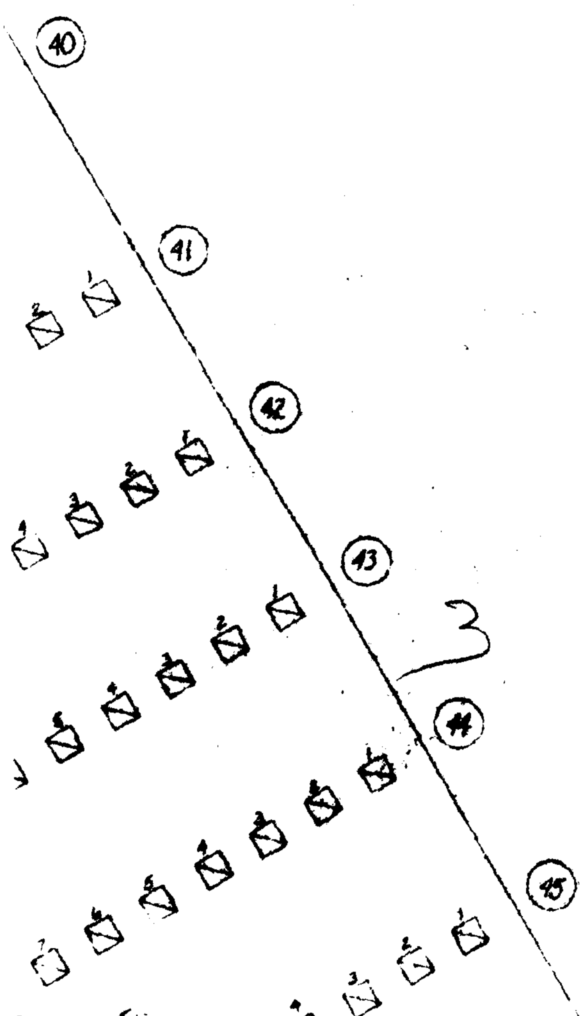
KEY

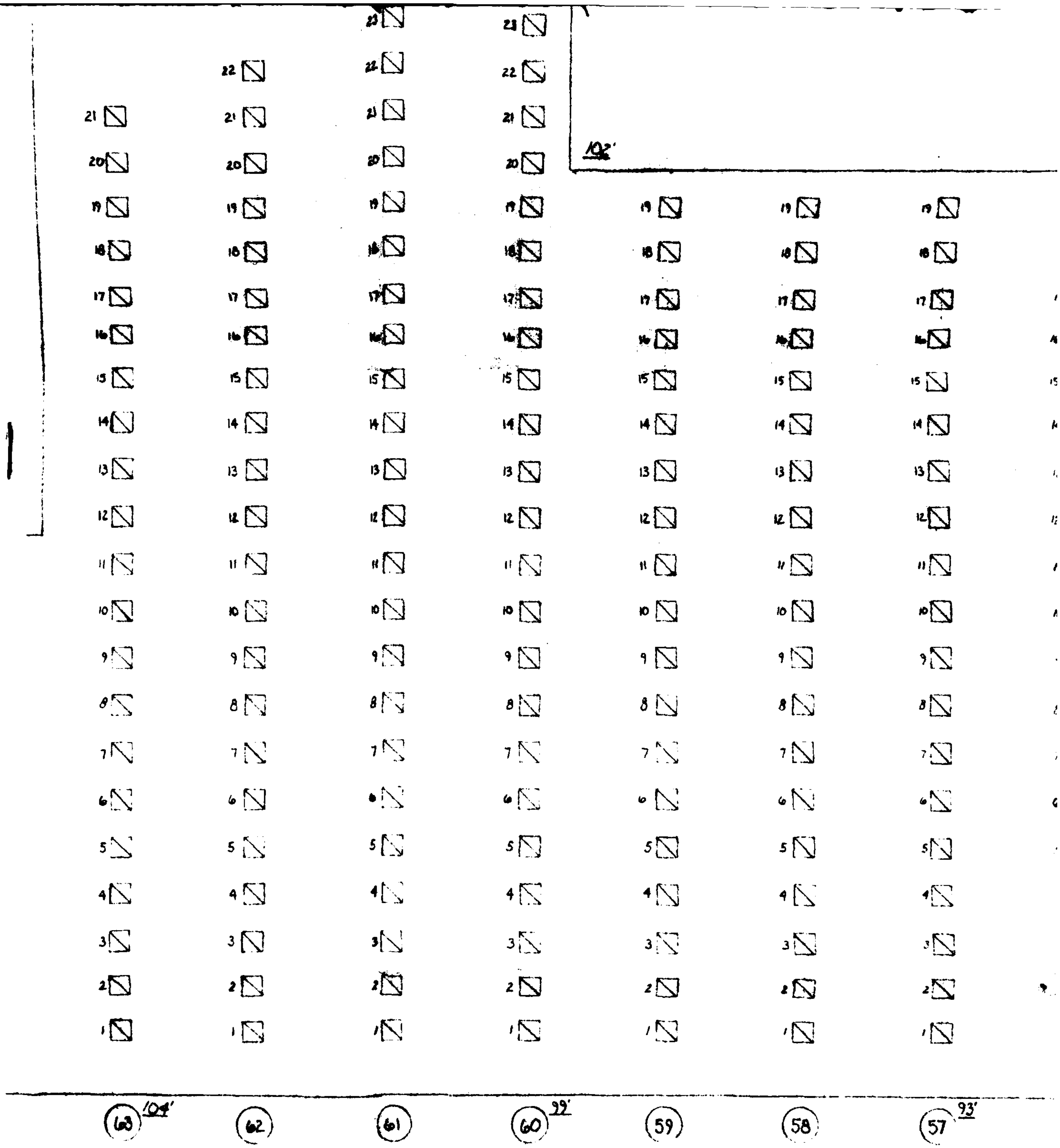
- □ SUPPORT PILE
- ⧅ PILE INSPECTED 6/81 CONDITION GOOD
- ◩ DAMAGED PILE
- ◯ BENT DESIGNATION
- 75 SOUNDINGS (FEET BASED ON M.S.L.)

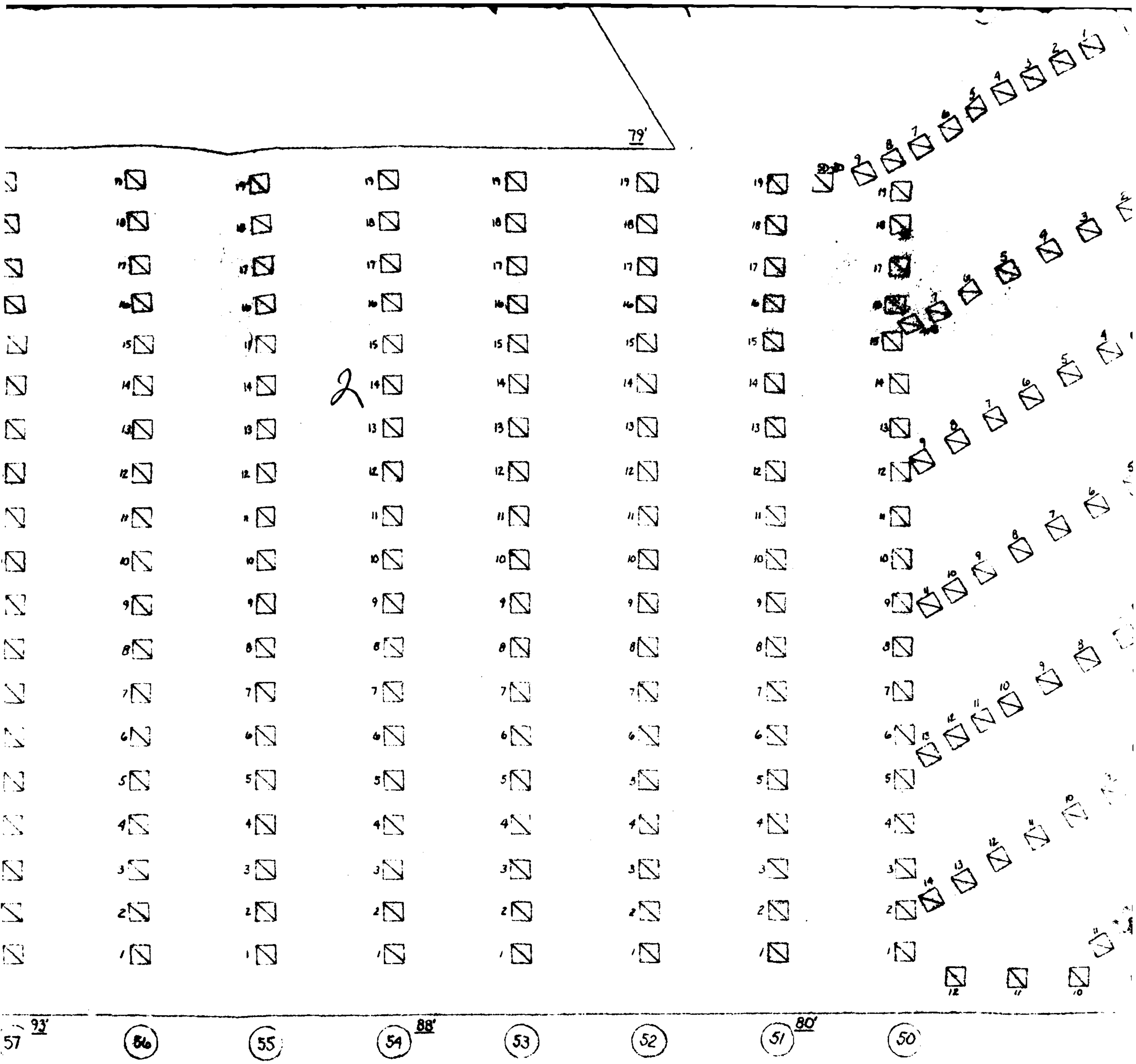
TOTAL CONCRETE PILES THIS SHEET : 377

TOTAL PILES INSPECTED : 377






102'
104'
99'
93'
63
62
61
60
59
58
57



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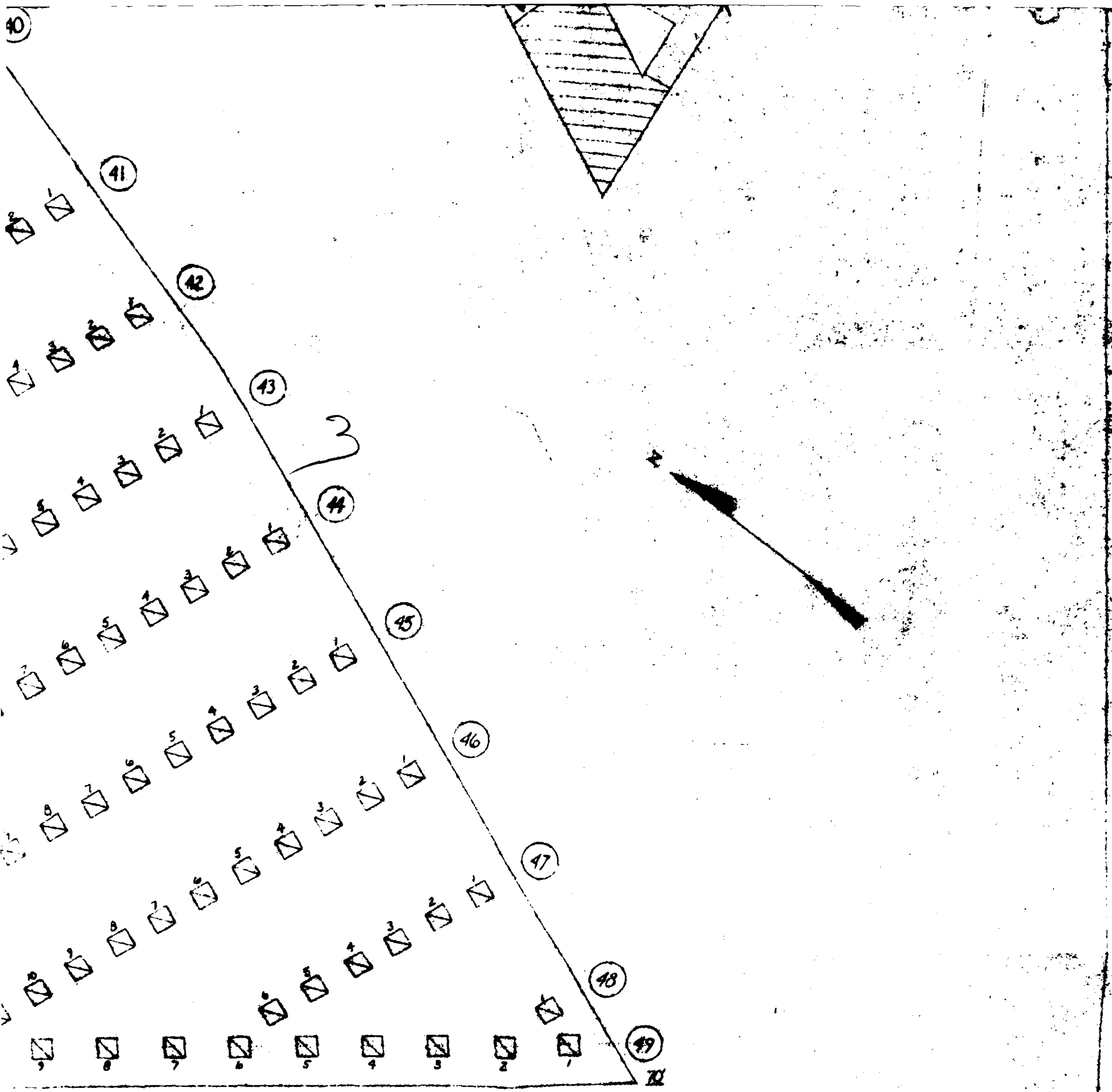


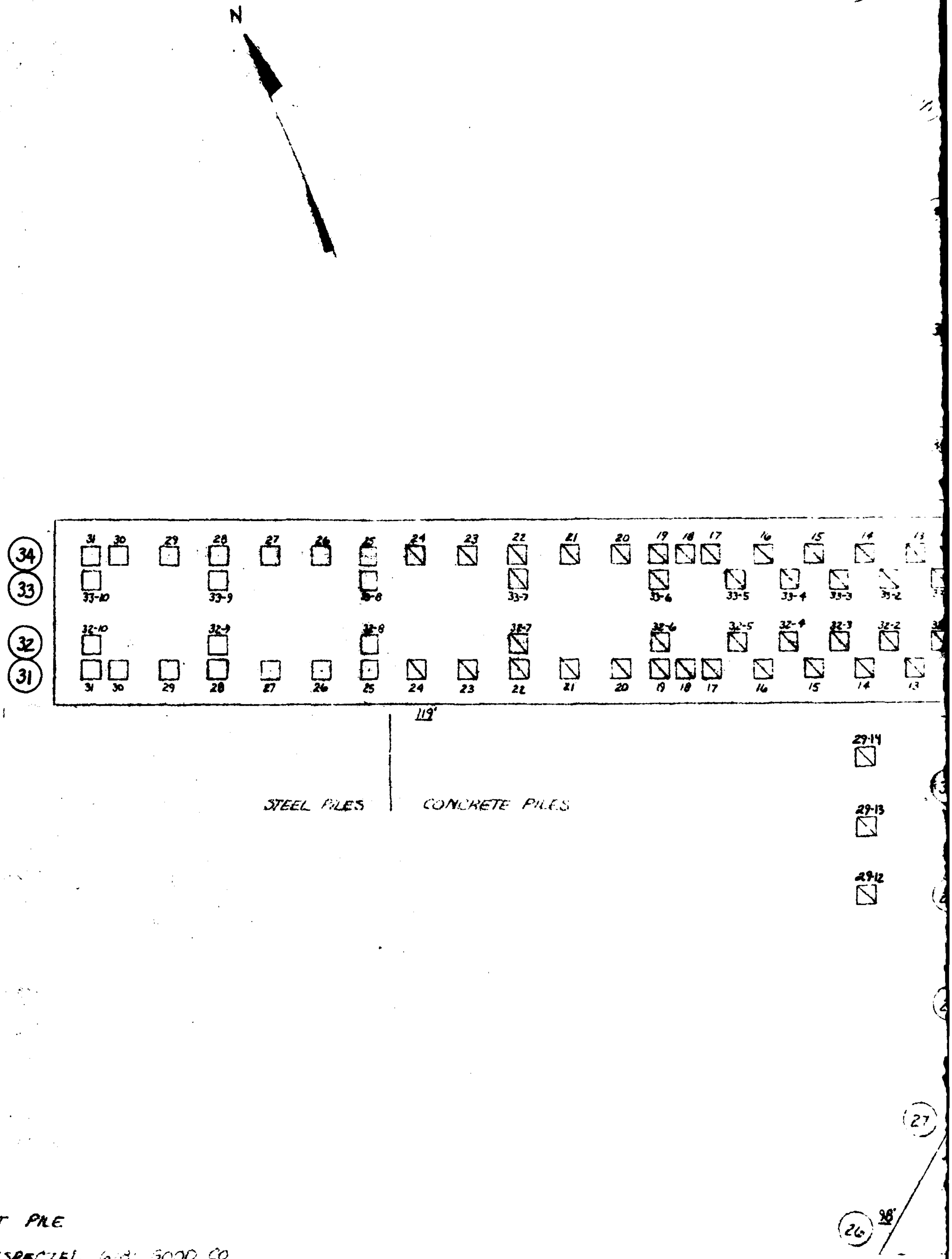
2 OF 4

PILE PLAN - REFIT 1 & 2

TRIDENT REFIT FACILITY, BANGOR, WASHINGTON

UNDERWATER FACILITY ASSESSMENT CHESDIV, NAVFACENGCOM CONTRACT N-62477-80-C-0233 WISWELL, INC SOUTHPORT CT	DATE 7/17/81 SCALE NOT TO SCALE DRAWN BY BMS APPROVED BY RH REVISED 9/2/81

6

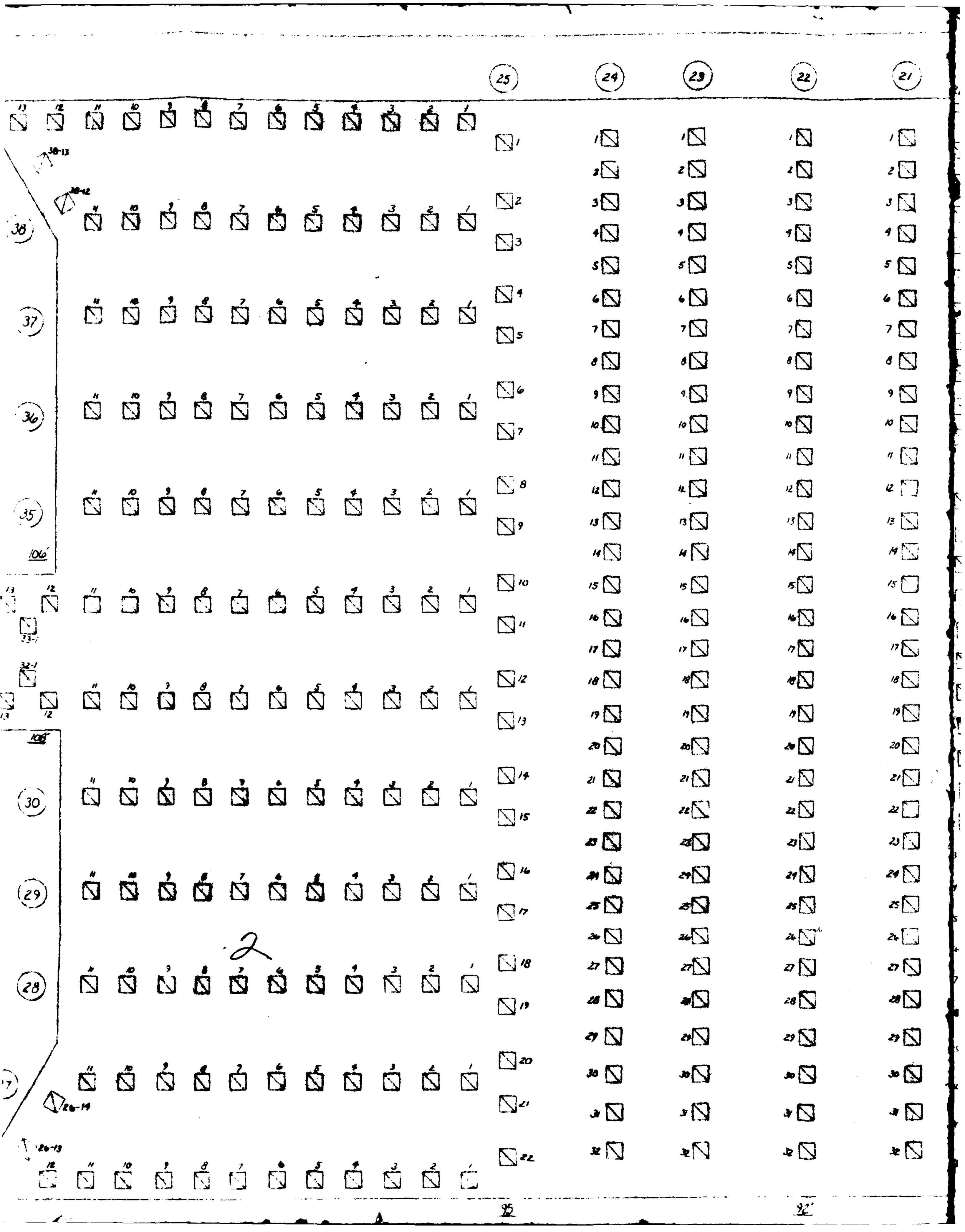


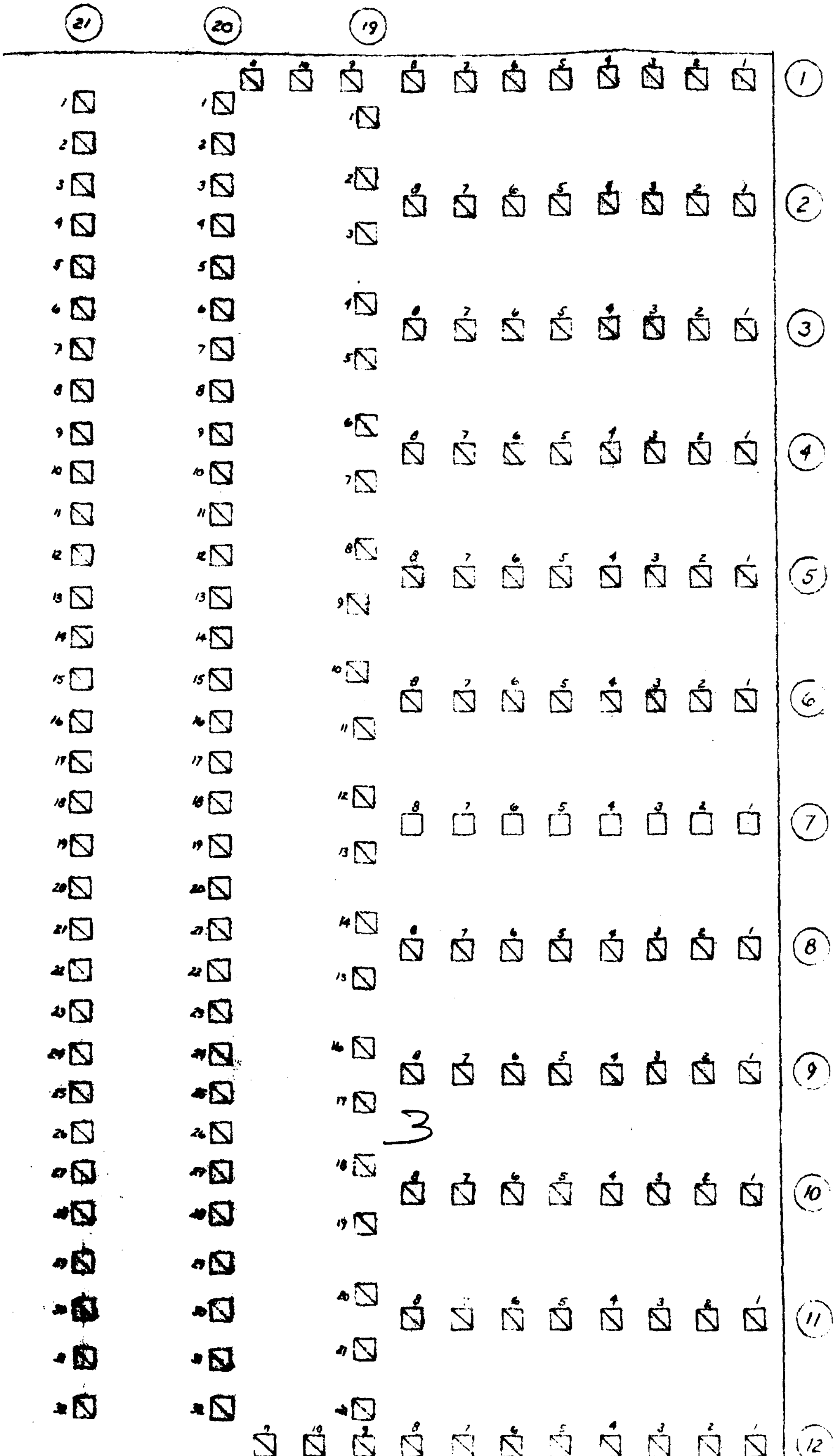
KEY

SUPPORT PILE

PILE INSPECTED
GOOD CONDITION

DAMAGED PILE


25
24
23
22
21
38
37
36
35
106'
30
29
28
2
95
92'

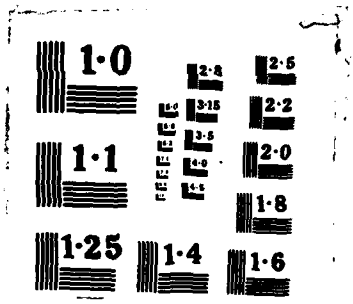


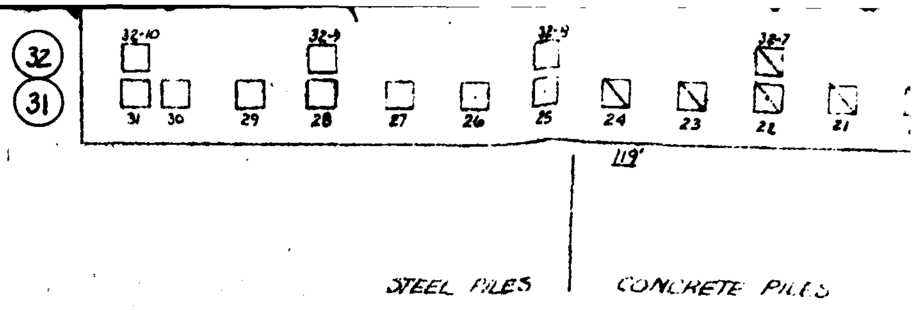
82

AD-A167 459 UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT REFIT PIERS 1 & 2 TR..(U) MITRE CORP MCLEAN VA JASON PROGRAM OFFICE JUN 81 CHES/NAVFAC-FPO-1-82 (02)0041 2/2

UNCLASSIFIED N62477-80-C-0233 F/G 13/2 NL

END
DATE
FILMED
6-86
DTIC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5



KEY

SUPPORT PILE

PILE INSPECTED 6/81, GOOD CO
GOOD CONDITION

DAMAGED PILE

BENT DESIGNATION

75' SOUNDINGS (FEET)(BASED ON M.S.L.)

TOTAL CONCRETE PILES THIS SHEET : 554

TOTAL INSPECTED : 554

TOTAL STEEL PILES THIS SHEET : 20

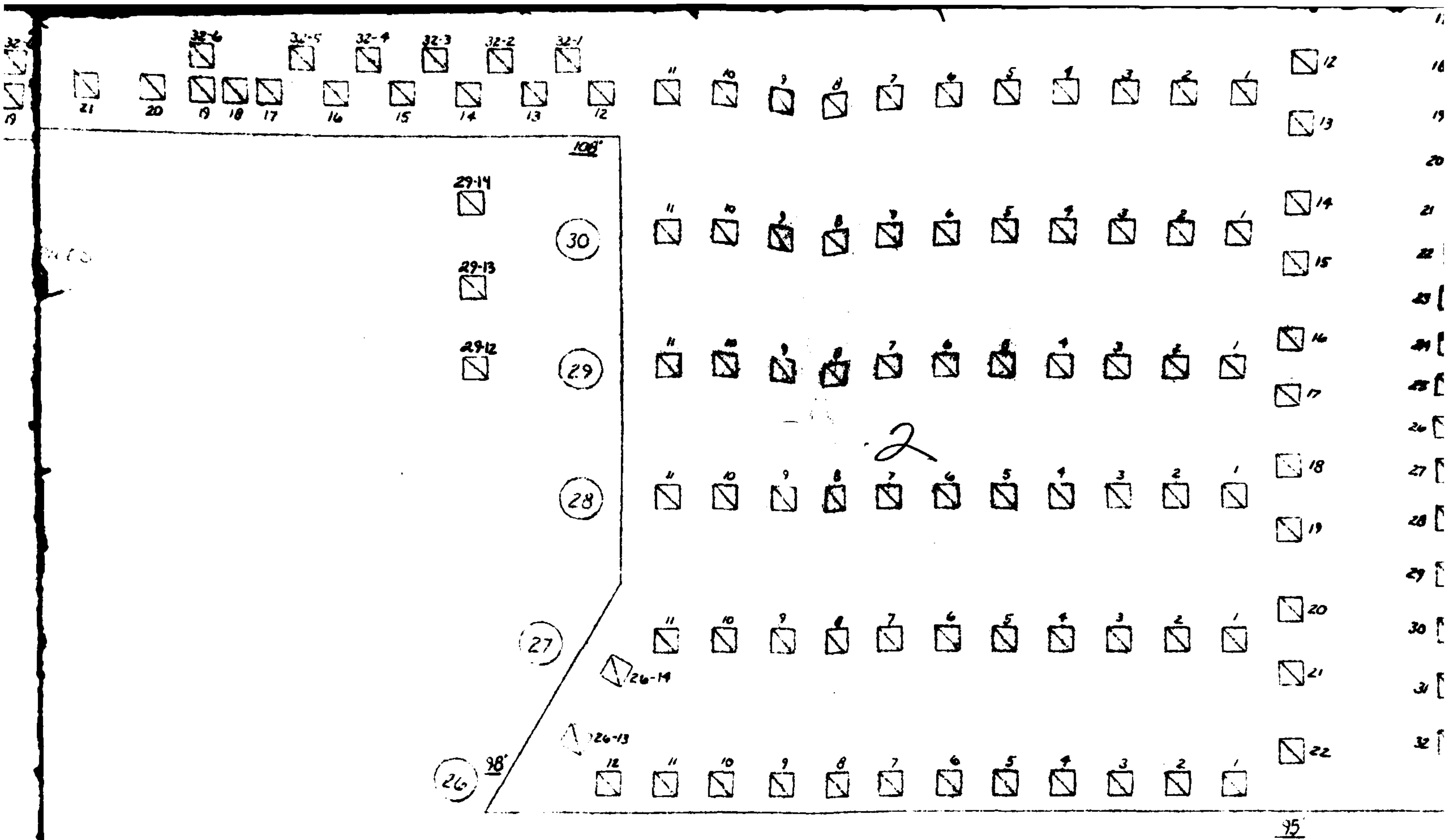
TOTAL INSPECTED : 0

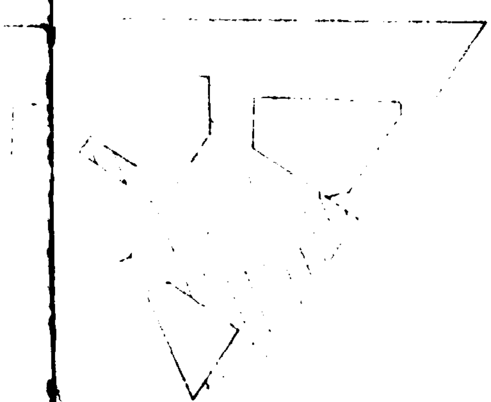
3 OF 4

PILE PLAN - REFIT 1 & 2

TRIDENT REFIT FACILITY, BANGOR, WASHINGTON

UNDERWATER FACILITY ASSESSMENT	DATE 7/17/81
CHESDIV NAVFACENGCOM	SCALE NOT TO SCALE
CONTRACT N-62477-80-C 0233	DRAWN BY BMS
WISWELL, INC., SOUTHPORT, CT	APPROVED BY RHJ
	REVISED 9/6/81


32-6
32-5
32-4
32-3
32-2
32-1
108'
29-14
29-13
29-12
30
29
28
27
26
26-14
26-13
98'
95'
2



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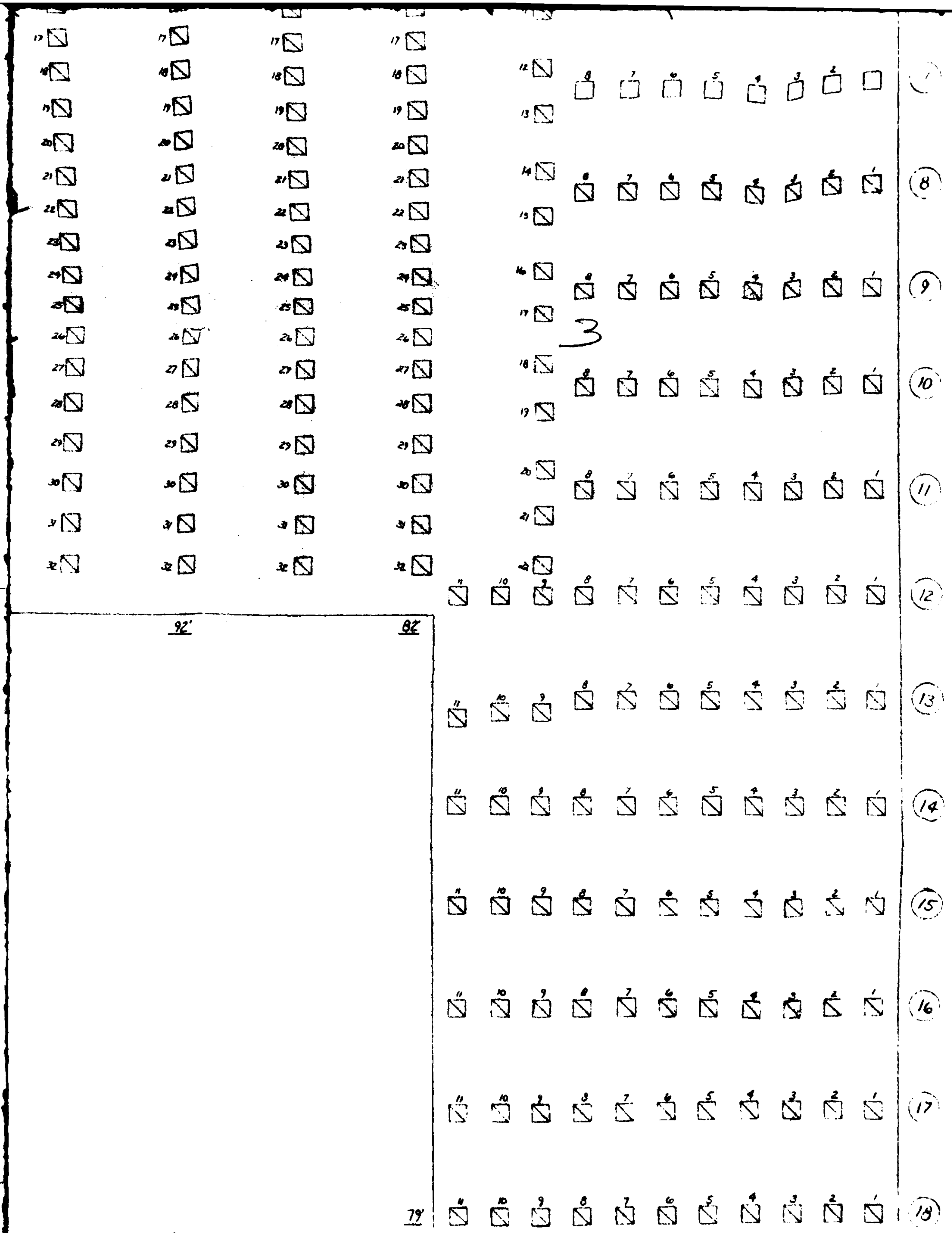
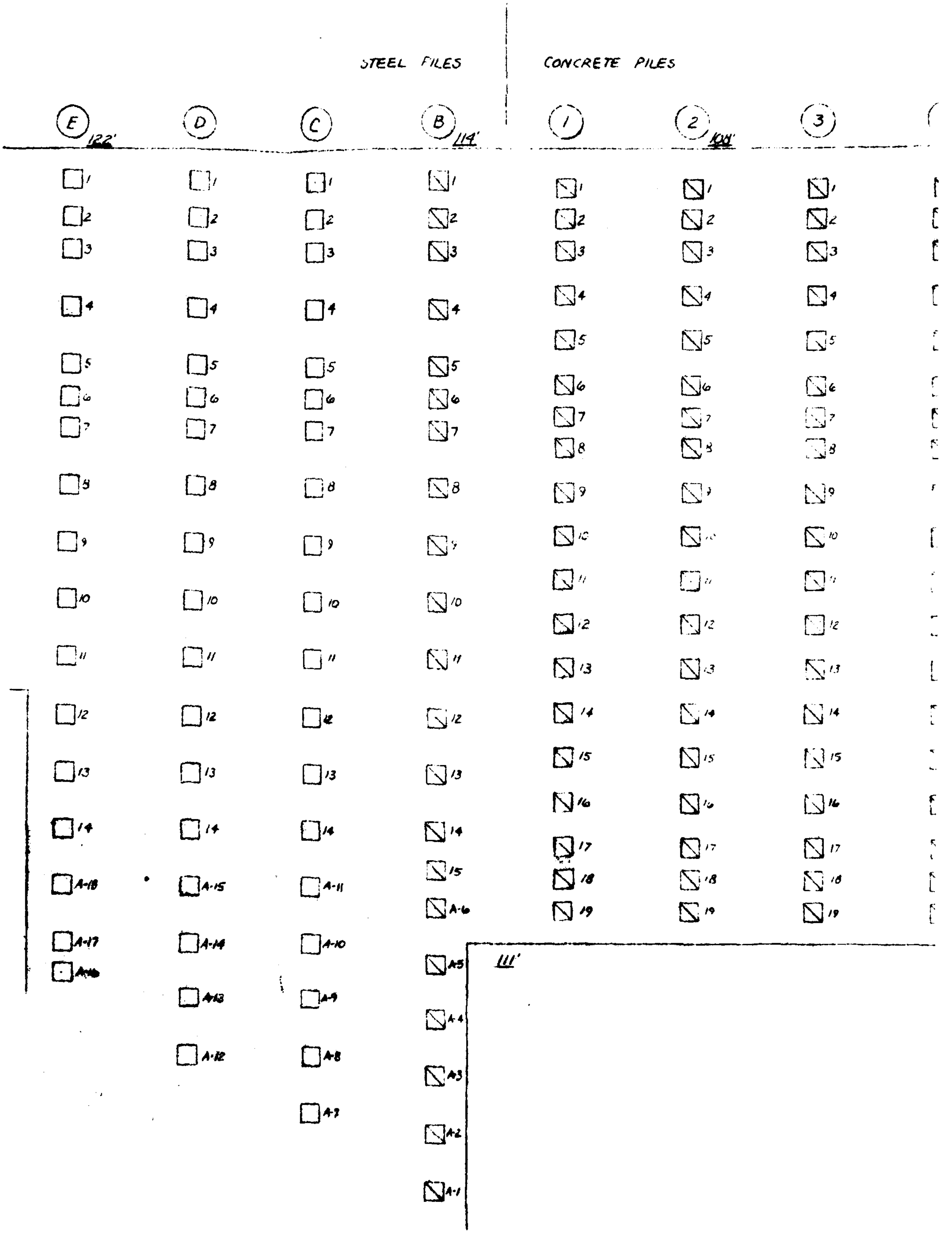
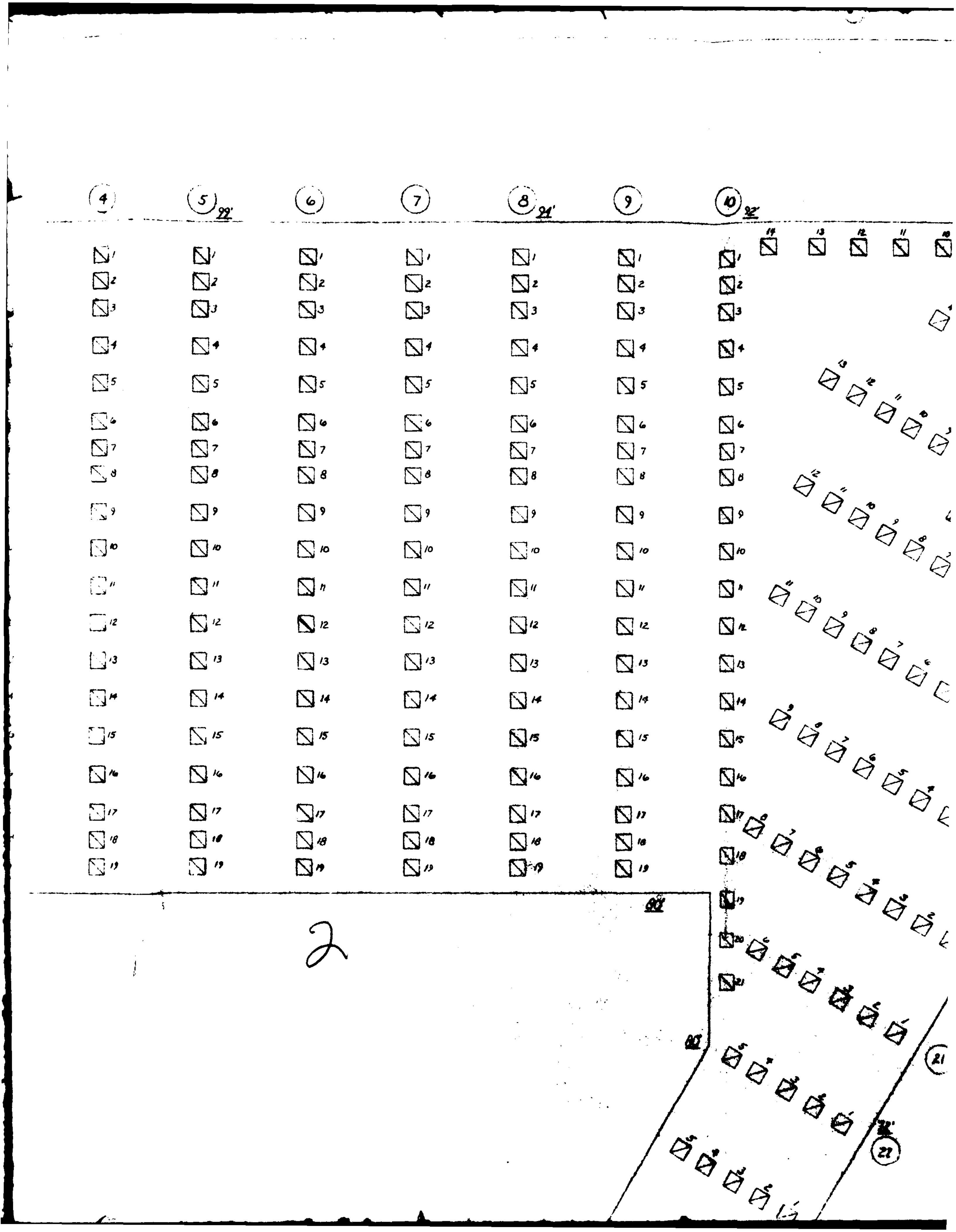
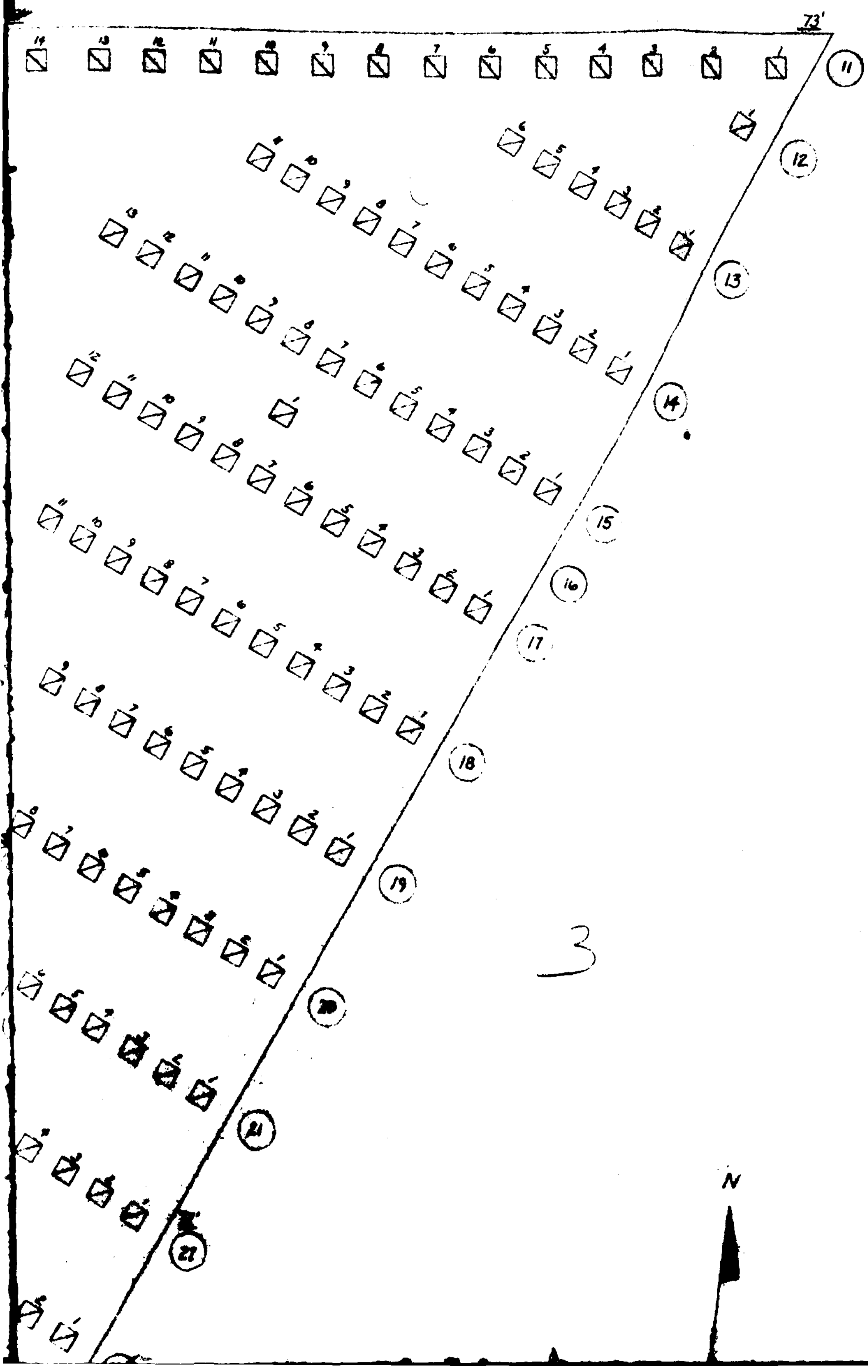


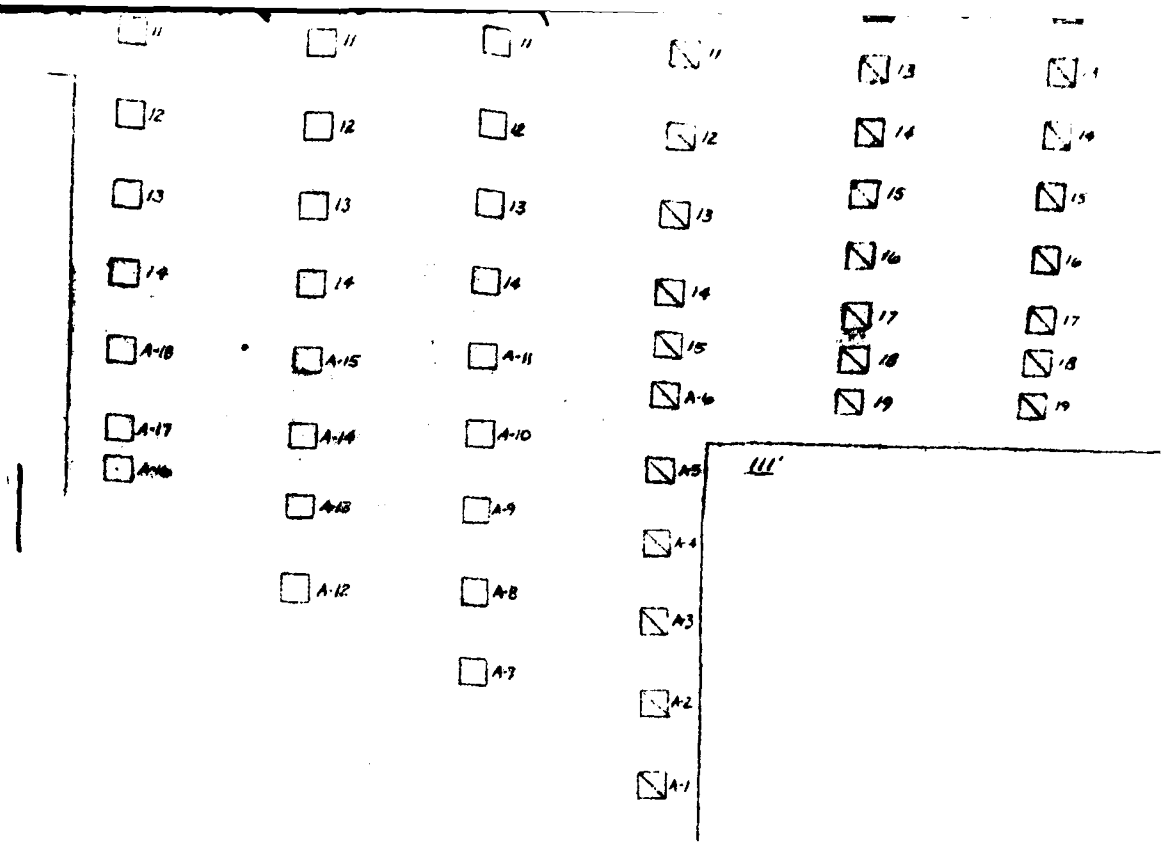
6


STEEL PILES
CONCRETE PILES
E 122'
D
C
B 114'
1
2 108'
3
111'



4
5
92'
6
7
8
91'
9
10
92'
60'
60'
2
21
22


73'
11
12
13
14
15
16
17
18
19
20
21
22
3
N



KEY

☐ SUPPORT PILE

⧅ PILE INSPECTED 6/81
CONDITION GOOD

■ DAMAGED PILE

◯ BENT DESIGNATION

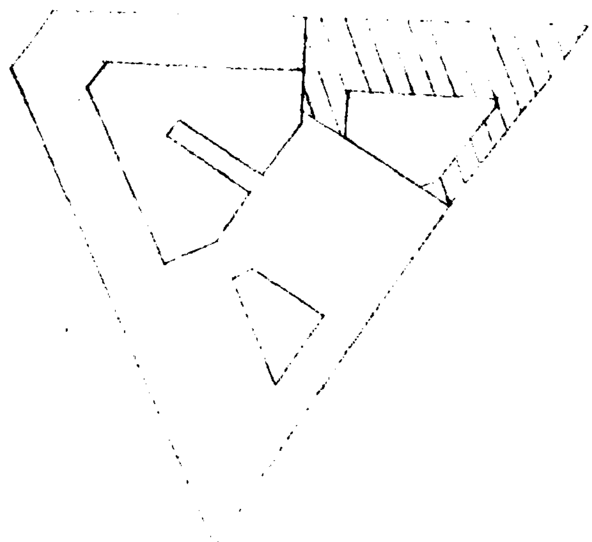
15' SOUNDINGS (FEET, BASED ON MSL)

TOTAL CONCRETE PILES THIS SHEET : 316

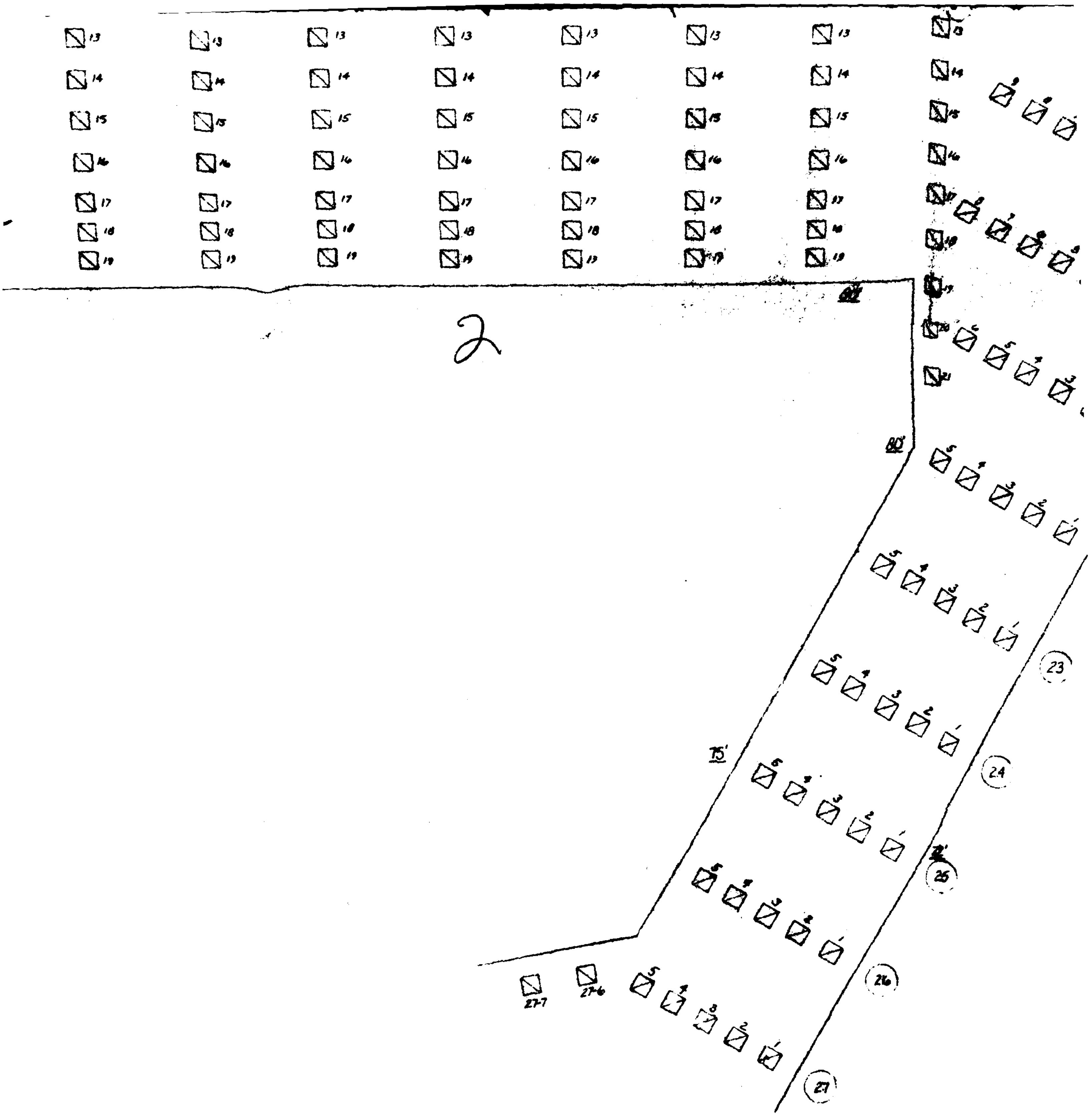
TOTAL INSPECTED : 316

TOTAL STEEL PILES THIS SHEET : 74

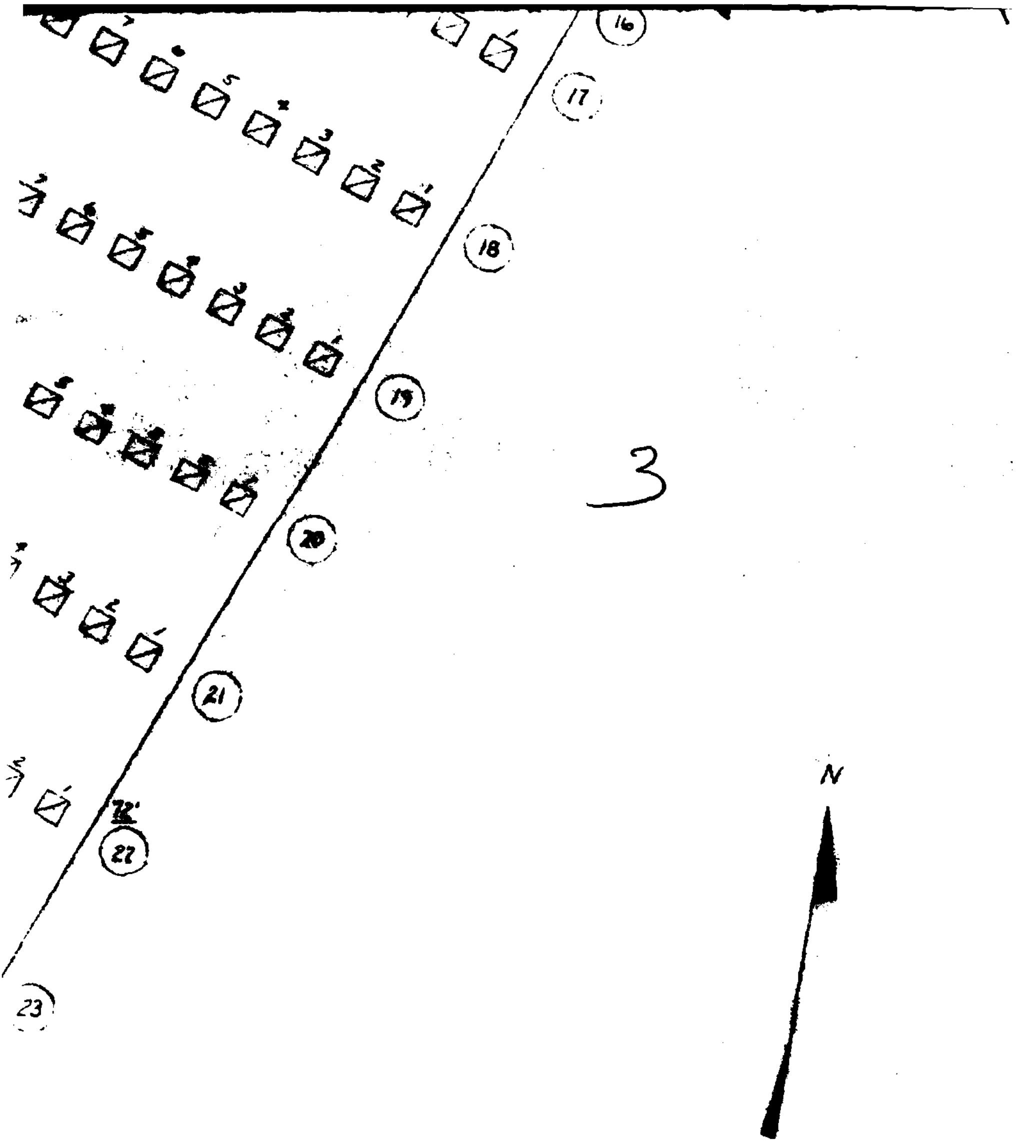
TOTAL INSPECTED : 21



4



5



3

4 OF 4

PILE PLAN · REFIT 1 & 2

TRIDENT REFIT FACILITY. BANGOR, WASHINGTON

UNDERWATER FACILITY ASSESSMENT	DATE 7/17/81
CHESDIV. NAVFACENGCOM	SCALE NOT TO SCALE
CONTRACT N-62477-80-C-0233	DRAWN BY BMS
[illegible] VELL INC., [illegible] PORT [illegible]	APPROVED BY [illegible]
	[illegible]

6

END

DATE
FILMED

6-86

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